2016-1054

In The
United States Court of Appeals
For The Federal Circuit

BLUE SPIKE, LLC,

Plaintiff – Appellant,

v.

GOOGLE INC.,

Defendant – Appellee.

APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA IN CASE NO. 4:14-CV-01650-YGR, JUDGE YVONNE GONZALEZ ROGERS.

BRIEF OF APPELLANT

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CERTIFICATE OF INTEREST

Counsel for plaintiff-appellant hereby certifies the following:

1. The full name of every party represented by me is:

Blue Spike, LLC

2. The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by me is:

The real parties in interest are named in the caption.

3. All parent corporations and any publicly held companies that own 10 percent of more of the stock of the party or amicus curiae represented by me are:

No parent corporations or publicly held companies own 10 percent or more of the stock of the party represented by Garteiser Honea, nor does Garteiser Honea represent any amicus curiae.

4. The name of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or agency or are appearing in this Court are:

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ABBREVIATIONS AND CONVENTIONS

Abbreviation	Meaning	Appendix Location
Signal Abstract	The “abstract” claim limitation; as distinguishable from “abstract” in the § 101 eligibility context.	N/A
District Court	The United States District Court for the Northern District of California.	N/A
Patents-in-Suit	U.S. Patent Nos. 7,346,472, 7,600,700, 7,949,494, 8,214,175, and 8,712,728	Appx0023, Appx0038, Appx0052, Appx0069, Appx0084
’472 patent	U.S. Patent No. 7,346,472	Appx0023
’700 patent	U.S. Patent No. 7,600,700	Appx0038
’494 patent	U.S. Patent No. 7,949,494	Appx0052
’175 patent	U.S. Patent No. 8,214,175	Appx0069
’728 patent	U.S. Patent No. 8,712,728	Appx0084

STATEMENT OF RELATED CASES

The following five (5) cases are stayed in the United States District Courts for the Eastern District of Texas and the Northern District of California pending the outcome of this appeal.

Case Name	Case No.	Court
Blue Spike, LLC v. Gracenote, Inc., et al.	15-cv-1494	N.D. Cal.
Blue Spike, LLC v. Miranda Tech., Inc, et al.	15-cv-0598	E.D. Tex.
Blue Spike, LLC v. Audible Magic Corp.	15-cv-584	E.D. Tex.
Blue Spike, LLC v. Facebook, LLC	15-cv-4185	N.D. Cal.
Blue Spike, LLC v. WiOffer, LLC, et al.	15-cv-585	E.D. Tex.
Blue Spike, LLC v. Adobe Systems, Inc.	16-1075 (appeal)	Fed. Cir.
	15-1803 (cross-appeal)	Fed. Cir.

JURISDICTIONAL STATEMENT

This appeal arises from a decision of the United States District Court for the Northern District of California. The District Court had jurisdiction under 28 U.S.C. §§ 1331 and 1338(a). The District Court granted Defendant's motion for judgment on the pleadings on September 8, 2015 and issued final judgment on October 1, 2015. Plaintiff timely filed a notice of appeal on October 5, 2015. This Court has jurisdiction under 28 U.S.C. § 1295(a)(1).

STATEMENT OF ISSUES

I. *Section 101 Eligibility – Prong 1*: Whether Blue Spike is entitled to a judgment of eligibility where the Patents-in-Suit are not directed to an abstract idea.

II. *Section 101 Eligibility – Prong 2*: Whether Blue Spike is entitled to a judgment of eligibility where the Patents-in-Suit, if directed to an abstract idea, add an inventive concept and are not preemptive.

III. *Improper Section 112 Analysis* – Whether the District Court's § 101 decision should be reversed and remanded for improperly addressing § 112 concerns.

STATEMENT OF THE CASE

Blue Spike, LLC ("Blue Spike") is a small company specializing in digital watermarking technology and other means of identifying digital signals. This sort of technology has important applications, including protecting copyrighted digital content from piracy. At the time the patents at issue in this case were filed, digital signal recognition focused primarily on inserting data into a digital signal (a "digital watermark"). Blue Spike's patents introduced a novel alternative to digital watermarking; rather than inserting data into a digital signal, Blue Spike's technology creates an abstract ("Signal Abstract")—a smaller digital representation of the digital signal—that can be used for identification purposes. The central question in this appeal is whether Blue Spike's digital abstracting technology is patentable subject matter under § 101 of the Patent Act.

A. Preliminary Statement.

The District Court granted Google's motion for judgment on the pleadings, holding that Blue Spike's patents were "generally directed to the abstract concept of comparing one thing to another," and therefore ineligible for patent protection. (Appx0008.) But this interpretation of the patents—issued without the benefit of claim construction proceedings—was breathtakingly broad. All inventions rely, at bottom, on fundamental

principles and natural laws, and all patents can thus be construed at such a high level of generality that they are stripped down to an underlying "abstract idea." The District Court erred by looking past the particular contributions described in Blue Spike's patents.

The District Court also held that Blue Spike's patent claims "do not involve any 'inventive concept.'" (Appx0010.) Those claims, the court said, "merely discuss using routine computer components and methods." *Id.* That holding ignored the patents' claims to describe a particular method of signal comparison that overcomes practical difficulties in the field of signal recognition.

The District Court's skepticism of Blue Spike's patents may derive from a belief that Blue Spike had not, in fact, actually discovered and implemented a practical method of signal abstracting. Any such belief would be incorrect. But more important for present purposes, these sorts of concerns are not appropriately addressed under § 101, but rather are the domain of § 112 of the Patent Act, which requires that the patent specification "enable" the invention. Google did not move for judgment under § 112, and any argument about inadequate enablement would certainly have implicated factual disputes inappropriate for resolution on a Rule 12(c) motion. It is no more appropriate, however, to import § 112 concerns into

the § 101 analysis, thereby forgoing the opportunity for factual development that adjudicating such concerns requires.

B. Procedural History.

On August 22, 2012, Blue Spike filed its original complaint against Google in the Eastern District of Texas, alleging infringement of the ’472, ’700, ’494, and ’175 Patents. (Appx0293.) On March 13, 2014, the Court granted Google’s motion for transfer to the Northern District of California. (Appx0414.) Blue Spike filed its First Amended Complaint (“FAC”) on September 15, 2015, alleging infringement of the same four patents asserted in its original complaint along with U.S. Patent No. 8,712,728 (“the ’728 Patent”) (collectively with the ’472, ’700, ’494 and ’175 Patents, “the Patents-in-Suit”). (Appx1488.) Google answered Blue Spike’s FAC on October 2, 2015. (Appx0401.) The Court granted the parties’ joint stipulation to extend case deadlines through claim construction by roughly four months in order to facilitate the completed transfer of other cases from the Eastern District of Texas as well as in anticipation of the likely relation of several transferred cases involving the same Patents-in-Suit. (Appx0112.)

The Eastern District of Texas has previously issued a number of substantive rulings in a related case relevant to Google’s motion. On October 16, 2014, that court with the assistance of a court-appointed

technical advisor issued a 69-page *Markman* opinion construing more than 30 terms and phrases in the Patents-in-Suit. (Appx1965.) On that same date, Magistrate Judge Craven issued a 19-page Report and Recommendation recommending that a motion for summary judgment based on indefiniteness be denied. (Appx2034.) In an 11-page Memorandum Order on January 6, 2015, Judge Schneider adopted the Magistrate Judge's findings, affirming the denial of summary judgment of indefiniteness. (Appx0284.)

On May 12, 2015, during what Blue Spike understood to be a stand-down period on motion practice, Google filed a Rule 12(c) Motion for Judgment on the Pleadings seeking adjudication that the Patents-in-Suit are invalid under 35 U.S.C. § 101 (the "§ 101 Motion"). (Appx2103.) Blue Spike opposed Google's Rule 12(c) Motion. (Appx2270.) On October 1, 2015, the Northern District of California ("District Court") entered judgment against Blue Spike, finding the asserted claims of the Patents-in-Suit invalid pursuant to Section 101. (Appx0001.) Four days later, Blue Spike appealed. (Appx0115.)

STATEMENT OF FACTS

A. The Patents-in-Suit.

The Patents-in-Suit teach a "novel basis" for signal recognition and identification. (Appx0069, '175 Patent 2:4-7, 6:63-66). This "enhanced

identification" is carried out by (1) monitoring and analyzing a digital signal (Appx0069, '175 Patent, 3:11-12, 22-23, 32-33, 48-49); (2) creating a smaller digital representation known as an "abstract" (a "Signal Abstract") of that digital signal (Appx0069, '175 Patent, 3:13-21, 23-24, 33-35; 51-52); and (3) utilizing the Signal Abstract to make comparisons and perform other useful operations (e.g. creating an index-of-relatedness (Appx0023, '472 Patent, Claim 11); embedding uniquely identifiable data into a digital signal (Appx0038, '700 Patent, Claim 12); identifying related digital signals (Appx0038, '700 Patent, Claim 40); and changing selected criteria to effect different results in creating the Signal Abstract (Appx0069, '175 Patent, Claim 5)).

The key to the process is the Signal Abstract. It is a data-reduced representation of a digital signal allowing complex comparisons at lower bandwidth than comparisons of the raw digital signal. (*See*, *e.g.*, Appx0069, '175 Patent, 6:54-7:9; 9:59-10:6; 10:10-19; 12:42-51.) This Signal Abstract is "created using data reduction techniques to determine the smallest amount of data, at least a single bit, which can represent and differentiate two digitized signal representations." (Appx0069, '175 Patent, 10:10-19.) The Patents-in-Suit describe an embodiment in which an abstract is created by the following steps:

> 1) analyze the characteristics of each signal in a group of audible/perceptible variations for the same signal (e.g. analyze each of five versions of the same song—which versions may have the same lyrics and music but which are sung by different artists); and 2) select those characteristics which achieve or remain relatively constant . . . .

(Appx0069, ’175 Patent, 4:7-17.) This process of creating a Signal Abstract attempts to “reduce the digital signal in such a manner as to retain a ‘perceptual relationship’ between the original signal and its data reduced version.” (Appx0069, ’175 Patent, 3:65-4:1.) The resulting Signal Abstract is non-invertible, meaning that that it cannot be used to recreate the original digital signal. (Appx0069, ’175 Patent, 13:55-60.) Once Signal Abstracts are created, they may be compared to digital signals or to each other. (Appx0069, ’175 Patent, 7:42-49.)

Comparing digital signals to each other without the use of a Signal Abstract can be a computationally expensive way to identify a signal. (Cf. Appx0069, ’175 Patent, 7:4-10.) At the time of the invention, the prevailing solution for this problem of computer-based “identification of digitally-sampled information” relied largely upon adding “a separate and additional signal,” such as a digital watermark, to the original signal. (Appx0069, ’175 Patent, 4:51-55.) The Patents-in-Suit provide a salient example: “One traditional, text-based additive signal is title and author information. The title and author, for example, is information about a book, but it is in

addition to the text of the book.” (Appx0069, ’175 Patent, 4:58-61.) One of the “many shortcomings” of the additive signal approach is the difficulty of creating an additive signal that could not be removed surreptitiously. (Appx0069, ’175 Patent, 5:1-12.)

Blue Spike’s patents addressed these deficiencies. (“The purpose is to afford a more consistent means for classifying signals than proprietary, related text-based approaches.” (Appx0069, ’175 Patent, 4:2-4); The solution was the Signal Abstract: a representation of a digital signal that “massively compress[ed] a signal to its essence” while not compressing so much that the resulting abstract “fails to maintain the ability to distinguish” signals. (Appx0069, ’175 Patent, 7:10-34.) “The present invention eliminates the need of any additive monitoring signal because the present invention utilizes the underlying content signal as the identifier itself.” (Appx0069, ’175 Patent, 5:26-28).) The Patent and Trademark Office rigorously assessed these advantages in comparing the Patents-in-Suit to literally hundreds of prior art patents and publications. Hence, the ’472 Patent cites more than 100 references; the ’700 Patent cites more than 350 references; the ’494 and ’175 Patents each cite almost 600 references; and the ’728 Patent cites more than 700 references.

The Patents-in-Suit draw from "the highly effective ability of humans to identify and recognize a signal." (Appx0069, '175 Patent, 4:44-46). If a Signal Abstract can be "compressed to retain what is 'humanly-perceptible'" and "successfully mimics human perception, data space may be saved when the compressed file is compared to the uncompressed original file." (Appx0069, '175 Patent, 7:43-46). But the signal abstracts yet teach improvements of human-based comparisons and identification.

One such improvement includes a faster and more accurate form of identification. (Appx0069, '175 Patent, 7:4-10.) The '175 Patent's first sample embodiment thus teaches the identification of copyrighted songs. (Appx0069, '175 Patent, 13:39-14:35.) Other applications exist outside of media rights. For instance, the same patent's second sample embodiment describes "identification of photographs of potential suspects whose identity matches the sketch of a police artist." (Appx0069, '175 Patent, 14:62-65.)

The claims also contain other improvements over human-based comparisons. For example, the Patents-in-Suit teach reconstructing abstracts based on selectable criteria upon matching collision (Appx0023, '472 Patent, Claim 9), creation of an index-of-relatedness (Appx0023, '472 Patent, Claim 11), a security controller granting access to a secured area (e.g. a biometric reader) (Appx0023, '472 Patent, Claim 12), differentiation between versions

of a signal (Appx0052, ’494 Patent, Claim 1), and authorizing transmission or use of a signal based on matching criteria (Appx0038, ’700 Patent, Claim 18).

The Patents-in-Suit provide a 5-step prose algorithm spanning multiple columns of the specification. (Appx0069, ’175 Patent, 8:3-9:40); Appx2034 (referring to the Blue Spike Patents-in-Suit and noting “the specification provides an exemplary algorithm in prose.”); *contra* Appx001 (“The Court further notes that the specification does not teach the specifics of the implementation—it includes no source code, *detailed algorithm or formulas*, or the like.”) (emphasis added). The algorithm provides five elements: (1) a reference database, (2) an object locator, (3) a feature selector, (4) a comparing device, and (5) a recorder. (Appx0069, ’175 Patent, 8:3-9:40.) Additionally, the patents point to various other algorithms that could be utilized in the creation the abstract. (Appx0069, ’175 Patent, 4:18-32; 10:56-12:11 (referring to algorithms such as linear predictive coding (LPC), z-transform analysis, root mean square (rms), frequency weighted RMS, signal to peak, and spectral transforms).) Despite the

detailed specification, Google argued in its § 101 Motion that these specifications did not adequately enable the invention under § 112.[1]

B. Blue Spike and Scott Moskowitz.

Scott Moskowitz is Blue Spike's founder and manager, as well as co-inventor on all of the Patents-in-Suit. (Appx0332-333, ¶ 2.) Mr. Moskowitz filed his first digital-content-management patent in 1993 and has continued to contribute to the field of digital signal processing and its application to technological problems. (Appx0334, ¶ 10.) One of his early patents in this technological space was innovative enough that the USPTO could not classify it under its existing labeling system, earning the patent an entirely new category: "classification 713, subclass 176, called 'Authentication by digital signature representation or digital watermark'." (Appx0335, ¶ 12.) And at least one of his patents garnered government interest when the NSA classified the patent under a secrecy order "while it investigated his pioneering innovations and their impact on national security." (Appx0335-336, ¶ 13.) Mr. Moskowitz has been cited by *The New York Times*, interviewed by *Forbes*, and has testified before the Library of Congress regarding the Digital Millennium Copyright Act. (Appx0336, ¶ 15.) He is a

[1] On reply, Google averred it did not intend to raise § 112 arguments. (Appx2492, n.5.)

senior member of the Institute of Electrical and Electronics Engineers (IEEE), a member of the Association for Computing Machinery, and the International Society for Optics and Photonics (SPIE) and has written books since translated into other languages, spoken at conferences, and peer-reviewed numerous conference papers. (Appx0337, ¶ 14-16.)

Mr. Moskowitz has applied his digital signal processing knowledge in a number of products, and he and Blue Spike continue "to produce new versions of its popular digital-watermarking tools" including "unique Scrambling technologies" and an "end-to-end solution for music security." (Appx0338, ¶ 21.) Mr. Moskowitz' technology has "been at the forefront" of industry-based tests such as the MUSE Embedded Signaling Tests and Secure Digital Music Initiative ("SDMI"). (Appx0337, ¶ 17.) "To this day, Mr. Moskowitz and Blue Spike are working with artists to help them manage and secure their valuable artistic contributions. . . ." (Appx0338, ¶ 21.)

SUMMARY OF ARGUMENT

Every valid patent builds on abstract principles and laws of nature. And every patent can be described at a sufficiently high level of generality to make it abstract, unoriginal, or banal. In this case, the District Court did just that: It characterized Blue Spike's patents, which claim a method of

comparing digital signals based on a Signal Abstract of the original signal, as claiming the entire notion of "comparing one thing to another." This reduced the Patents-in-Suit to an absurdity, and it rendered them ineligible for patent protection under § 101 of the Patent Act.

This was error. The District Court misapplied both parts of the *Alice/Mayo* test for patentability under § 101. First, it erroneously concluded that the Patents-in-Suit were directed to an abstract idea by construing those patents at an overly high level of generality. It would be absurd to try and patent "comparing one thing to another," and Blue Spike did not attempt to do so. Rather, it patented a particular approach to comparing digital signals that eschews both comparison of entire signals and inserting a digital signature or watermark, and instead employs data reduction techniques to create a Signal Abstract from the underlying signal. The District Court overlooked the particularity of Blue Spike's approach, however, because it focused on the problem addressed rather than the means employed, improperly sought to boil the patents down to their "gist," and attempted to resolve patent eligibility on a Rule 12(c) motion for judgment on the pleadings, prior to any resolution of disputes about construction of the patent claims.

Second, the District Court wrongly rejected Blue Spike's argument that, even if its patents were directed to an abstract concept, they nonetheless added a patentable "inventive concept." Blue Spike's reliance on the Signal Abstract overcomes recognized technical obstacles in the field, employs computers in a non-routine way, and satisfies the "machine or transformation" test. Moreover, the Patents-in-Suit's inventive concept is sufficiently narrow to avoid preempting a wide variety of other means of digital comparisons. In concluding otherwise, the District Court improperly conflated the patentability of Blue Spike's invention with concerns about its novelty, even though novelty is both conceptually distinct and bound up with factual disputes that may not be resolved on a Rule 12(c) motion.

Finally, Google repeatedly suggested to the District Court that Blue Spike had not actually invented anything, and that its patents therefore did not and could not sufficiently enable the invention under § 112. Google could not hope to resolve this disputed factual issue on a Rule 12(c) motion, and it was ultimately forced to disavow its § 112 argument in its reply brief. But the record demonstrates that these concerns about § 112 enablement infiltrated the District Court's § 101 analysis. This left Blue Spike in the worst of all possible worlds, forced to rebut aspersions about enablement in a procedural context that foreclosed developing evidence necessary to do so.

The District Court's venture beyond the pleadings thus provides an independent ground for reversal here.

Congress framed § 101 to provide broad and robust protection for innovation. The District Court's decision here, however, both construed § 101 in a way that encourages attacks on patent eligibility and expanded the scope of Rule 12(c) motions for judgment on the pleadings in a way that will make those attacks hard to rebut. The judgment invalidating Blue Spike's patents should be reversed.

STANDARDS OF REVIEW

Section 282 of the Patent Act provides that "[a] patent shall be presumed valid," 35 U.S.C. § 282; hence, the movant bears the burden of establishing invalidity. *See Microsoft Corp. v. i4i Ltd. Partn.*, 564 U.S. 91 (2011). The Federal Circuit reviews *de novo* a district court's determination of patent-eligibility under 35 U.S.C. § 101. *DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1255 (Fed. Cir. 2014). Similarly, the Federal Circuit reviews a grant of judgment on the pleadings *de novo*. *buySAFE, Inc. v. Google, Inc.*, 765 F.3d 1350, 1352 (Fed. Cir. 2014). In reviewing a district court's grant of a motion for judgment on the pleadings, the Federal Circuit applies the procedural law of the regional circuit. *Amgen Inc. v. Sandoz Inc.*, 794 F.3d 1347, 1354 (Fed. Cir. 2015).

ARGUMENT

Section 101 of the Patent Act provides that "[w]hoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. § 101. However, the Supreme Court has "long held that this provision contains an important implicit exception: Laws of nature, natural phenomena, and abstract ideas are not patentable." *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2354 (2014) (internal marks omitted). The Court has fashioned a two-step process in determining Section 101 eligibility: "First, we determine whether the claims at issue are directed to one of those patent-ineligible concepts." *Alice*, 134 S. Ct. at 2355 (citing *Mayo Collaborative Svcs. v. Prometheus Laboratories, Inc.*, 132 S. Ct. 1289, 1296-97 (2012)). If they are, then the second stage of the inquiry asks whether the patent contains an "inventive concept," such that the invention "amounts to significantly more than a patent upon the ineligible concept itself." *Id.* at 2355.

Blue Spike contends that the District Court erred at both stages of this *Mayo-Alice* test. The Patents-in-Suit are not directed to an abstract idea, and even if they were, those patents also add a significant inventive concept.

Moreover, the District Court inappropriately conflated § 101's eligibility inquiry with the enablement requirement of § 112—an issue which, if confronted directly, would have required significant factual development in order to resolve.

I. THE PATENTS-IN-SUIT ARE NOT DIRECTED TO AN ABSTRACT IDEA.

Section 101 eligibility begins with an inquiry into "whether the claims at issue are directed to a patent-ineligible concept." *Alice*, 134 S. Ct. at 2350. The District Court erred by construing the claims here as "generally directed to the abstract concept of comparing one thing to another." (Appx0008.) This overly general characterization is analogous to construing patents on telephony as directed toward the abstract concept of "person-to-person communication," or patents on electronic calculators as directed toward the abstract concept of "doing mathematics." In fact, the Patents-in-Suit teach a particular method of comparing audio signals, replacing the prior art of inserting a digital watermark into signals with creating a Signal Abstract of the signals themselves. This innovation is plainly patentable subject matter under § 101.

A. The District Court Characterized the Patents-in-Suit at an Overly High Level of Generality.

Every patent involves abstract principles, just as every scientific advance ultimately rests on unpatentable laws of nature. Hence, Justice Breyer recognized in *Mayo* that "too broad an interpretation of this exclusionary principle [for abstract principles and laws of nature] could eviscerate patent law. For all inventions at some level embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas." 132 S. Ct. at 1293. Likewise, this court has "long-recognized that any claim can be stripped down, simplified, generalized, or paraphrased to remove all of its concrete limitations, until at its core, something that could be characterized as an abstract idea is revealed." *Ultramercial, Inc. v. Hulu, LLC*, 722 F.3d 1335, 1344 (Fed. Cir. 2013), *cert. granted, judgment vacated. sub nom. WildTangent, Inc. v. Ultramercial, LLC*, 134 S. Ct. 2870 (2014). If every patent were construed at the highest level of generality, then nothing would be patentable. And short of that extreme, broad constructions of patent claims risk undermining Congress's intent to provide generous protection for inventors as well as the general statutory presumption of

patent validity.[2] That is why this court has cautioned that "[a] court cannot go hunting for abstractions by ignoring the concrete, palpable, tangible limitations of the invention the patentee actually claims." *Id.*

The District Court made this very mistake by over-generalizing the Patents-in-Suit. Assessing Claim 1 of the '472 as representative, the District Court held "that the claims at issue are generally directed to the abstract concept of comparing one thing to another." (Appx0008.) Not even Google proposed such a broad construction of the patents' claims; rather, it proposed that the "gist" of Blue Spikes' patents involved "comparing one signal to another using perceivable qualities of the signal." (Appx2119.)[3] In any event, both the District Court's and Google's generalizations overlooked key aspects of the patent claims. To begin, the Patents-in-Suit contain "concrete, palpable, tangible limitations" to the particular matter of digital signal comparisons. They address a particular engineering problem within that limited field—that is, the problem that comparing signals in their entirety is

[2] *See* 35 U.S.C. § 282 (patents presumed valid once granted); *Bilski v. Kappos*, 561 U.S. 593, 602 (2010) ("This Court has more than once cautioned that courts should not read into the patent laws limitations and conditions which the legislature has not expressed.") (internal marks and citations omitted).

[3] Blue Spike argues that the Patents-in-Suit should be construed more specifically still, but it submits that even Google's characterization was not directed toward an abstract idea, and the District Court did not hold otherwise.

prohibitively inefficient, while inserting a digital watermark to identify signals provides inadequate security against illicit copying. The Patents-in-Suit address this problem by relying on the Signal Abstract, which is a distilled version of the original signal and yet derived from that signal itself rather than a separate (and thus removable) added watermark. Hence, Claim 1 describes "creating an abstract of said at least one reference signal . . . using perceptual qualities of the at least one reference signal such that the abstract retains a perceptual relationship to the reference signal from which it is derived." (Appx0023, '472 Patent, 15:36-43.)[4]

Although the District Court recognized that the "abstract" is "a key term at issue in every asserted claim" (Appx0008-09), its characterization of the Patents-in-Suit as simply involving "comparing one thing to another" dismisses Blue Spike's abstract-based approach as irrelevant. If a patent's particular approach to signal comparison is irrelevant, then it is hard to know what advances in the field would be patentable.[5] All those advances would

[4] As described above, the specification provides a prose algorithm further detailing the creation of this Signal Abstract.

[5] This is why one might suspect that the District Court doubted that Blue Spike had in fact developed a new method of signal comparison. But that is an issue of whether the Patents-in-Suit adequately *enabled* the invention under § 112—not a question of whether such an invention would be patentable under § 101. *See infra* Part III.

be characterizable as directed toward the abstract concept of "comparing one thing to another."

Once one rejects the conclusion that no innovation involving "comparing one thing to another" is patentable, then it is easy to see that the Patents-in-Suit are not directed toward an impermissibly abstract concept. This Court's cases rejecting patentability have generally involved patents that teach well-known, fundamental concepts.[6] But the Patents-in-Suit are not directed toward any such concept. On the contrary, the Patents-in-Suit teach tangible improvements over the prior art methods for digital signal recognition. (*See*, *e.g.*, Appx0069, '175 Patent, 2:4-7, 6:63-66.) They teach the creation of a data-reduced representation of a digital signal (a Signal Abstract) that retains perceptual characteristics of that signal. (*See* Appx0069, '175 Patent, 3:65-4:1, 4:7-17, 10:10-19.) It was this inventive approach to digital signal processing and recognition that the USPTO deemed worthy of patent protection over hundreds of prior art references.

[6] *See*, *e.g.*, *buySAFE, Inc.*, 765 F.3d at 1355 (finding an abstract idea because the patents taught "long-familiar commercial transactions"); *Content Extraction and Transmission LLC v. Wells Fargo Bank, Nat. Ass'n*, 776 F.3d 1343, 1347 (Fed. Cir. 2014) (finding an abstract idea because the "concept of data collection, recognition, and storage is undisputedly well-known"); *OIP Technologies, Inc. v. Amazon.com, Inc.*, 788 F.3d 1359, 1364 (Fed. Cir. 2015) (finding an abstract idea because "the claims merely recite well-understood, routine, conventional data-gathering activities").

Reducing a signal to an abstract for purposes of comparison is hardly comparable to hedging to reduce financial risk, *see Bilski*, 561 U.S. at 611 (2010), or the use of a financial intermediary to mitigate risk of nonperformance of an agreement, *see Alice*, 134 S. Ct. at 2356, that the Supreme Court held unpatentable in its leading cases.

Other cases have held patents invalid under § 101 where they merely purport to organize human activity.[7] Here, however, the Patents-in-Suit do not organize human activity, but rather teach a method of creating a digital signal representation (the Signal Abstract) that facilitates complex digital signal comparisons. The Patents-in-Suit teach a 5-step prose algorithm, refer to a number of other algorithms, and provide a host of variations in the specification and claims for different needs (including greater matching accuracy through additive signals, encryption, and hashing). The Patents-in-Suit apply a novel technology that improves the functioning of the computer itself by reducing the amount of data that needs to be analyzed (e.g. the

[7] *See Intell. Ventures I LLC v. Capital One Bank (USA)*, 792 F.3d 1363, 1367 (Fed. Cir. 2015) (finding an abstract idea because the patent was "not meaningfully different from the ideas found to be abstract in other cases before the Supreme Court and our court involving methods of organizing human activity"); *see also Content Extraction*, 776 F.3d at 1347 (indicating a specific area of potentially ineligible human activity as "claims directed to mere formation and manipulation of economic relations").

reference Signal Abstracts) in order to perform the comparison, matching, and identification functions.[8]

This Court has provided guidance on claims "necessarily rooted in computer technology" such as those here. *See DDR Holdings*, 773 F.3d at 1257. Like *DDR Holdings*, Blue Spike's patents "do not merely recite the performance of some business practice known from the pre-Internet world along with the requirement to perform it on the internet." *Id.* Rather, in both *DDR Holdings* and the present case, "the claimed solution is necessarily rooted in computer technology in order to overcome a problem specifically arising in the realm of computer networks." *Id.* The asserted claims do not port business methods to a computer; they solve a real-world problem by generating a data-reduced Signal Abstract based on perceptual characteristics.

B. The District Court's Approach Inherently Tends Toward Over-Generalization of Patent Claims.

Many legal tests require courts to select an appropriate level of generality at which to characterize phenomena, and that selection poses some of the most difficult problems in the law. No one asserts that the task

[8] *Compare Alice*, 134 S. Ct. at 2359 ("The method claims do not, for example, purport to improve the functioning of the computer itself or effect an improvement in any other technology or technical field.").

Alice and *Mayo* set for the district courts is an easy one. But at least three aspects of the District Court's approach here tend to lead the inquiry astray. First, the District Court began with the wrong question: It asked whether the *problem* or *task* that the patent addressed was an abstract one, rather than whether the *solution* that the patents proposed was inherently abstract. Second, the District Court followed Northern District of California precedent directing courts to distill the "gist" of a patent in assessing its eligibility under § 101. This notion of a "gist" inherently presses courts toward a higher level of generality and thus inappropriately raises the bar for patentability under the Act. Finally, the District Court rendered its conclusions about the abstraction of the patents' claims without having conducted a hearing or considering evidence on claim construction. Given that the § 101 inquiry turned completely on the District Court's construction of the patents' claims, short-circuiting that process was bound to—and did—lead to error.

1. The Wrong Question.

The Patents-in-Suit do not attempt to patent the concept of comparing one thing to another; rather, finding an efficient and practical means of comparing digital signals is the problem that the patents undertake to solve. The Patents-in-Suit claim one particular approach to that problem,

employing a Signal Abstract, and they point out the advantages of that approach over competing approaches (such as digital watermarking). The suitability of the claimed approach for patent protection must be the focus of the inquiry under § 101.[9] In *Bilski*, for example, the Court did not ask whether the problem of financial risk was impermissibly abstract; rather, it asked whether the generic hedging strategies claimed in the patent were an impermissibly abstract means of addressing that problem. *See* 561 U.S. at 611-12.

Problems will often be more general than the particular approaches to solving those problems. Hence, focusing on the problem rather than the patented solution biases the inquiry toward abstraction. But even if this were not true, it makes little sense to focus on problems rather than solutions. Blue Spike seeks patent protection for its digital abstracting technology, not for any alternative means by which one might undertake to compare digital signals. The question under § 101 is thus necessarily whether that abstracting approach is patentable subject matter.

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[9] Blue Spike would further contend that, in any event, the District Court mischaracterized the problem that the Patents-in-Suit address. While that problem does involve comparison, the patent claims are specifically directed toward the engineering problem of finding an intermediate means of comparing audio signals between the less-satisfactory alternatives of comparing the entire signal or relying on an additional digital signature inserted in the signal (a watermark). That is hardly an abstract problem.

2. "The Gist."

The District Court's error may have been facilitated by Northern District of California precedent, which begins a Section 101 analysis by reducing a patent to its "gist." *See Open Text S.A. v. Box, Inc.*, 78 F. Supp. 3d 1043, 1046 (N.D. Cal. 2015) ("In evaluating the first prong of the *Mayo/Alice* test, which looks to see if the claim in question is directed at an abstract idea, the Court distills the gist of the claim.").[10] In the present case, the District Court cited *Open Text S.A.* in concluding that "the Court must 'distill[] the gist of the claim[s].'" (Appx0006 (*quoting Open Text S.A.*, 78 F. Supp. 3d at 1046).) The District Court has not provided guidance on how to derive this "gist," and in practice the instruction to boil patent claims down to a "gist" urges toward over-generalization of patent claims.[11] Indeed, the *Open Text S.A.* opinion quoted with approval another district's conclusion that "[c]ourts should recite a claim's purpose at a reasonably high level of

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[10] *See also GT Nexus, Inc. v. Inttra, Inc.*, 2015 WL 6747142, at *4 (N.D. Cal. Nov. 5, 2015); *IPLearn-Focus, LLC v. Microsoft Corp.*, 14-CV-00151-JD, 2015 WL 4192092, at *1 (N.D. Cal. July 10, 2015).

[11] In *Open Text S.A.*, the district court seems to have read the relevant precedents to direct courts to ignore limitations in the claims in order to distill a patent's "gist," specifically describing those limitations as irrelevant in its parenthetical descriptions of the cases. *See Open Text S.A.*, 78 F. Supp. 3d at 1046.

generality." 78 F. Supp. 3d at 1047 (quoting *Enfish, LLC v. Microsoft Corp.*, 56 F. Supp. 3d 1167, 1173 (C.D. Cal. 2014)).[12]

The District Court was correct that this Court and the Supreme Court have described patents in general terms that by their very nature as summaries do not include all claim aspects. However, *Open Text S.A.* fails to note that each time this Court or the Supreme Court summarizes a patent, it glosses over additional limitations only if they (1) are not inventive, (2) are already described at a high level of generality, and/or (3) merely recite routine components. By seeking a general "gist" in *all* cases, *Open Text S.A.* inadvertently sanctioned the over-generalization of inventive steps such as, here, Blue Spike's Signal Abstract.

The District Court's over-simplification runs counter to this Court's approach in *Ultramercial*. In *Ultramercial*, this Court addressed the "abstract idea" inquiry by (1) noting that claim 1 of the '545 patent "includes eleven steps for displaying an advertisement in exchange for access to copyright media"; (2) summarizing the 11 claims "[w]ithout purporting to construe" them; and finally (3) noting that the "ordered combination of steps recites an abstraction—an idea, having no particular concrete or tangible

[12] Even the *Enfish* decision, however, did not endorse the District Court's approach here, which was to construe the patent claims at the *highest possible* level of generality.

form." *Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 714-15 (Fed. Cir. 2014). This Court then agreed with the lower court's summary. *See id.* at 714. Critically, however, that summary was not the *starting point* but rather the end point of this Court's careful analysis of the patent's specific claims.

Unlike *Ultramercial*, where no inventive steps were discarded in the summary, the District Court's holding here ignores the far-from-well-known process of creating a data-reduced, perceptually-based representation of a digital signal. It is imperative that courts refrain from summarizing a claim at a higher-level of generality that strips a claim of its inventive teachings.

3. Claim Construction.

The District Court decided Google's § 101 Motion prior to holding any proceedings to resolve disputes about claim construction of the Patents-in-Suit. This Court has stated,

> claim construction is not an inviolable prerequisite to a validity determination under § 101. We note, however, that it will ordinarily be desirable—and often necessary—to resolve claim construction disputes prior to a § 101 analysis, for the determination of patent eligibility requires a full understanding of the basic character of the claimed subject matter.

Bancorp Servs., LLC v. Sun Life Assur. Co. of Canada (U.S.), 687 F.3d 1266, 1273-74 (Fed. Cir. 2012). This is one of those cases where claim construction was not only "desirable," but "necessary," prior to resolving the

patents' eligibility under § 101. After all, the entire case came to turn on the District Court's extraordinarily broad interpretation of the patents' claims.[13]

Distilling a series of specific patent claims down to a "gist" is, for all practical purposes, a matter of claim construction. But it is a particularly inadequate substitute for *actual* claim construction, because it involves a largely impressionistic and indeterminate judgment conducted without the procedural safeguards that a prior hearing on claim construction would have afforded. A non-arbitrary process of distillation would require consideration not only of precisely what the patent does and does not claim, but also a comparison with prior art to determine what, if anything, is in fact new in the patent. Just as the "gist" of a precedential decision or an academic article is the new contribution that it makes to an evolving body of law or knowledge, the "gist" of a patent ought to be the new contribution that the patented innovation makes in its field. That determination would have

[13] The necessity of a claim construction hearing in this case is illustrated by the District Court's confusion regarding the patents' teachings. (*See*, *e.g.*, Appx2765, Transcript at 27:7-9.) This confusion resulted in cursory findings such as determining the specification contained no algorithm. (Appx0004.) That finding is explicitly contradicted by the Eastern District of Texas court, which benefited from claim construction, expert evidence, and full briefing and held that "the specification provides an exemplary algorithm in prose." (Appx2034.) The Eastern District of Texas's rulings demonstrate that factual inquiries are often necessary to a § 101 analysis. *Cf. DDR Holdings*, 773 F.3d at 1257 (in which this Court benefited from a full record and reversed a § 101 holding of ineligibility for the first and only time.)

required not only a hearing on claim construction, but possibly the development of arguments and evidence on novelty and enablement as well. In the absence of that sort of information, it is unsurprising that the District Court construed these patents at the highest possible level of generality.

C. Patents Involving the Automation of Functions that May be Performed by Humans Are Not Inherently Directed to Abstract Ideas.

The District Court found the Patents-in-Suit invalid in large part because they "seek to 'model,' on a computer, 'the highly effective ability of humans to identify and recognize a signal.'" (*See* Appx0084, '728 Patent at 4:47-48.) By their own terms, therefore, the patents simply seek to cover a general purpose computer implementation of an abstract idea long undertaken within the human mind." (Appx0008.) There are at least two problems with this reasoning. First, if the patents' claimed method of improving signal identification by creating and employing a digital abstract is not itself impermissibly abstract (as argued above), then those claims would not be *rendered* abstract simply because they sought to replicate on a computer a process performed by humans. Second, the Patents-in-Suit do *not* simply replicate a process performed by humans.

The Supreme Court's "abstract idea" cases have frequently dealt with efforts to patent the implementation of human processes on a computer. As

such, they have generated language suggesting that simply replicating ordinary human processes on a computer is not patentable subject matter. *See Alice*, 134 S. Ct. at 2357-58.[14] Generally, this issue has arisen at step *two* of the *Alice/Mayo* test. *See id.*; *Mayo*, 132 S. Ct. at 1301 (confirming that computer implementation of human processes is not inherently unpatentable at Step One). The District Court was thus wrong to suggest that the Patents-in-Suit were directed to an abstract idea because they "emphasiz[ed] the goal of modeling human capacity" on a computer (Appx0008) or because "[t]he method by which the claims contemplate enabling these comparisons mirrors the manner in which the human mind undertakes the same task. (Appx0009.) If Google patented a driverless car that replicated human driving skills, that patent would not be invalid under § 101 simply because it "mirrors the manner in which the human mind undertakes the same task."

Skepticism of patents claiming to computerize human processes in these cases has stemmed from the generic nature of the claims about computer implementation in the patents at issue. Hence, in *Alice*, the Court held that "the method claims, which merely require generic computer implementation, fail to transform that abstract idea [of intermediated settlement] into a patent-eligible invention." 134 S. Ct. at 2357. Likewise,

[14] *See also Content Extraction*, 776 F.3d at 1347 (noting that an abstract idea is not made eligible merely because it is performed on a machine).

this Court said in *Bancorp Services* that "[t]he use of a computer in an otherwise patent-ineligible process for no more than its most basic function—making calculations or computations—fails to circumvent the prohibition against patenting abstract ideas and mental processes." 687 F.3d at 1278. Both these cases suffered from two fatal defects: (1) the human process replicated was itself highly abstract, and (2) the claims regarding computer implementation were basic and generic. Neither is true in the present case.

The District Court was led astray by the Signal Abstract's ability to recognize human-perceptible characteristics. (*See* Appx0008 (noting the Patents-in-Suit are "intended to encompass computerized content comparisons based on human-perceptible characteristics.").) But the use of perceptual characteristics does not instantly classify an idea as abstract. If this were the case, Alexander Graham Bell's famous telephone patents—inventions that use a machine to recognize human-perceptible sounds—would not be considered eligible subject matter.[15] On the contrary, training a machine to perform human-like functions—when the computer is not

[15] *Cf. Bilski*, 561 U.S. at 620 n.2 (Stevens, J., concurring in the judgment) (citing for other purposes claim 5 of a telephone patent: "[t]he method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds . . . ." (citation omitted)).

innately organized to do so—is just the sort of concrete invention Section 101 was drafted to protect.

In any event, the Patents-in-Suit do not simply replicate human perception. Neither Google nor the District Court presented evidence that humans perform comparisons by reducing signals to data-reduced representations (nor is this factual dispute resolvable on a motion for judgment on the pleadings). And even if such evidence exists, the application of complex human ability on a machine is not "general purpose" or routine. *Compare Content Extraction*, 776 F.3d at 1347 (in which "general purpose" techniques include "data collection, recognition, and storage"). On the contrary, the Patents-in-Suit teach a concrete method of comparing digital signals by creating a data-reduced, perceptually-based, non-invertible representation (a Signal Abstract). Blue Spike's expert demonstrated that the Patents-in-Suit improve upon prior art, which also relied on computer processing of signals. (Appx2306-7, Papakonstantinou Declaration at ¶ 17.) While the use of computer technology alone does not make an invention eligible, improving upon existing computer-based technology in data reduction and comparison does.[16]

[16] It is worth noting that the process of expressing perceptual characteristics on a computer is by itself arguably *not* abstract because a computer is not innately capable of such representation without inventive programming. Expressing perceptual characteristics on a machine is not routine, compared to, for example, the data storage and retrieval in *Content Extraction*.

II. THE PATENTS-IN-SUIT ADD INVENTIVE STEPS THAT PREVENT PREEMPTION OF ANY ABSTRACT CONCEPT.

Even patent claims directed to an abstract concept can pass muster under § 101 if they add "an 'inventive concept'—i.e., an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself.'" *Alice*, 134 S. Ct. at 2355 (quoting *Mayo*, 132 S. Ct. at 1294). Courts must "consider the elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Id.* (quoting *Mayo*, 132 S. Ct. at 1298, 1297). The Supreme Court has made clear, however, that the ultimate question is "one of pre-emption"; by requiring that the patent add an inventive concept to the abstract idea, courts obtain "'practical assurance that the process is more than a drafting effort designed to monopolize the [abstract idea] itself.'" *Id.* at 2354, 2358 (quoting *Mayo*, 132 S. Ct. at 1297).

These concerns are more than satisfied here. The Patents-in-Suit obviously do not purport to preempt all technologies that involve "comparing one thing to another"—the abstract idea to which the District Court thought the patent claims were directed. Blue Spike has never asserted this degree of preemptive force, and even Google did not view the patents'

claims so broadly.[17] Rather, the Patents-in-Suit claim only a particular method of comparison, involving creation of a signal abstract, and its applications within the field of digital signal comparison.

Several aspects of the Patents-in-Suit clarify the inventive concept that these patents embody. First, Blue Spike's patents overcome a particular technological obstacle in the field of digital signal comparison. Second, they do not provide for merely generic implementation on a computer but instead specify a particular and innovative task for the computer to perform. Third, the patents do not preempt a wide variety of other approaches to digital signal comparison, including advances and refinements to the dominant mode of comparison at the time the patents were filed involving digital watermarks. And fourth, the Patents-in-Suit satisfy the "machine or transformation" test, which, although not dispositive, remains a helpful indication of an inventive concept.

In assessing whether the Patents-in-Suit contained an inventive concept, the District Court seems to have equated the patentability of the

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[17] Google contended that the "gist" of Blue Spikes' patents involved "comparing one signal to another using perceivable qualities of the signal." (Appx2119.) Although overbroad, this interpretation of the patents was limited to signal comparison and would not have preempted comparisons based on inserting imperceptible content, such as a digital watermark, in the original signal.

subject matter with its novelty. This Court and the Supreme Court have made clear, however, that these issues are distinct; because Google moved for judgment solely under § 101, any novelty issues were not properly before the District Court. Moreover, novelty issues have a factual component which ought to have precluded their resolution at the pleading stage.

A. That Patents-in-Suit Overcome Technological Dilemmas.

One clear instance of an inventive concept occurs where a patent applies an abstract principle in such a way as to overcome a recognized technological dilemma in its field. An example is *Diamond v. Diehr*, 450 U.S. 175 (1981), which upheld patent claims applying a well-known mathematical equation. As the Court explained in *Alice*, the *Diehr* patent used that equation "in a process designed to solve a technological problem in 'conventional industry practice.'" 134 S. Ct. at 2358 (quoting *Diehr*, 450 U.S. at 178).[18] Similarly, the Patents-in-Suit in the present case address known technological dilemmas in the digital signal processing field.

Prior to the Patents-in-Suit, digital signal identification relied heavily on modifying a digital signal with a "separate and additional signal" such as a digital watermark. (*See*, *e.g.*, Appx0069, '175 Patent, 4:51-55.) These

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[18] *See also OIP Technologies*, 788 F.3d at 1364 (emphasizing this aspect of *Diehr*).

watermarks—themselves patentable inventions—had to be separately added to a signal before they could be used in identification, and comparison methods predicated on watermarks were useless for signals that did not contain them. Moreover, a digital watermark that is added to the signal can, in many circumstances, be removed without destroying the underlying signal—thereby facilitating illicit copying.

The Patents-in-Suit addressed these problems by introducing a method of "faster and more accurate auditing of signals." (Appx0069, '175 Patent, 7:4-10.) A Signal Abstract is derived from the underlying signal itself, and can thus be used to identify a signal without the aid of an additional signal, such as a watermark. Moreover, one cannot render the original signal undetectable by use of the Signal Abstract without damaging the signal itself; hence, the Signal Abstract provides more robust protection against illicit copying.

The Patents-in-Suit's ability to produce "faster and more accurate" results should not be confused with this Court's warning that "claiming the improved speed or efficiency inherent with applying the abstract idea on a computer" is not "a sufficient inventive concept." *Intell. Ventures I LLC v. Capital One Bank (USA)*, 792 F.3d 1363, 1367 (Fed. Cir. 2015). *Intellectual Ventures* states that claiming inherent improvement provided by a computer

will not make an abstract idea patent-eligible. But Blue Spike's Patents-in-Suit are not claiming inherent improvements from computerizing the process of comparison; rather, they teach a new process of computerized comparison, based on the signal abstract, that solves problems with existing computerized comparisons based on digital watermarks. The signal abstract approach yields advantages not only in speed and efficiency but also accuracy,[19] and it works in contexts (like un-watermarked signals or signals from which the watermark has been removed) that existing technology cannot reach.

B. The Patents-in-Suit Utilize a Computer in a Non-Routine Way.

The *Alice/Mayo* line of cases has rightly rejected claims that generic computer implementation of an abstract concept is a sufficient inventive concept to sustain patentability under § 101. As we have already noted, *see supra* Part I.C, those cases involved patents that failed to limit their claims to a particular computerized approach.[20] The Patents-in-Suit here, however,

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[19] The improved accuracy taught by the Patents-in-Suit is particularly important in some contexts such as biometric identification where false positives or negatives can have drastic consequences. (*See, e.g.*, Appx0052, '494 Patent 13:25-26; *see also* Appx0052, '494 Patent, Claims 6, 20 (not asserted in this litigation).)

[20] *See, e.g.*, *buySAFE*, 765 F.3d at 1352 (finding a patent ineligible because it "describe[d] a well-known, and widely understood concept" and the computer was "used merely for processing").

teach the non-routine creation of a data-reduced representation of a digital signal (a Signal Abstract) that retains perceptual characteristics of that signal. Signal Abstracts are not merely "conventional computer activities or routine data-gathering steps." *See OIP Technologies, Inc.*, 788 F.3d at 1363 (citing *Alice*, 134 S. Ct. at 2359). Rather, the Patents-in-Suit teach complex representations of the original digital signal that are data reduced, non-invertible, and configured to retain perceptual relationships with the original signal.

This case would be analogous to the patents previously found ineligible if the Patents-in-Suit claimed the abstract concept of "comparing one thing to another" and then claimed simply to implement that comparison on a computer. But the Patents-in-Suit instead utilize a computer for complex calculations on a digital signal, the creation of a Signal Abstract, and the comparison of Signal Abstracts. These are not routine computer functions. They are different, moreover, from the leading approach at the time the patents were filed of using a computer to insert a digital watermark in an existing signal and then comparing signals based on the presence or absence of that additive watermark. Hence, the Patents-in-Suit "effect an improvement" in "other technology" and a "technical field" in a way that the patents in *buySAFE* did not. *See buySAFE*, 765 F.3d at 1354.

C. The Patents-in-Suit Do Not Preempt Invention.

Even if the claims were directed to the abstract idea of "comparing one thing to another," (*see* Appx0008), it is hard to understand how the asserted claims of the Patents-in-Suit could be said to claim the "buildin[g] block[s] of human ingenuity," or otherwise "disproportionately [tie] up the use of the underlying ideas." *Alice*, 134 S. Ct. at 2354 (internal citations omitted). As discussed above, the asserted claims transform the abstract idea of comparing one thing to another to developing a specific system for automating comparison across digital platforms in order to facilitate further improvements over the art such as providing for an index of relatedness between two signals. Critically, the inventive concept of a Signal Abstract encompasses just one method for comparison of digital signals. The specification highlights other methods of comparison and identification of digital signals, including through the use of "text-based additive signals" and digital watermarking. (*See*, *e.g.*, Appx0023, '472 Patent, 4:50-56, 5:5-17.) In addition, the Patents-in-Suit cite hundreds of prior art patents and publications, which remain available to those in the art for the comparison of signals.

Moreover, there remain many more ways to compare digital signals. One approach would be a direct comparison, analyzing two binary files

composed of 1s and 0s side-by-side on a bit-by-bit basis. One can imagine advances in computing power, for instance, that might render practical direct bit-by-bit comparison of large digital files, and the Patents-in-Suit would not preempt any such innovation. Rather, those patents offer a distinct, narrow approach of identifying perceptual characteristics and creating a data-reduced representation.

To the extent Google argues Blue Spike's Patents-in-Suit are preemptive because they are innovative or have applications to fields beyond digital signal identification, this is not an appropriate to the preemptive inquiry. Nothing in § 101 insists that inventions be of limited significance or have applications only within a narrow field. What is relevant is whether there are sufficient claim limitations to prevent the monopoly of an abstract idea. Even if the claimed approach based on digital signal abstracts could be used in another field, such as biometric identification, it would not preempt forms of comparison that did not rely on abstracting, such as comparison of the overall signal or insertion of a digital signature. Blue Spike's innovative Patents-in-Suit are sufficiently narrow and thus not preemptive.

Finally, the District Court rejected Blue Spike's argument that the Patents-in-Suit claim only a particular form of computer comparison by insisting that, "the claims are not limited to such complex activities, but also

encompass more basic approaches." (Appx0011.) Hence, the court concluded that the claims "cover and preempt a wide range of comparisons that humans can and, indeed, have undertaken from time immemorial." *Id.* Blue Spike submits that to read the Patents-in-Suit as covering and preempting all forms of human comparison is to render them absurd. But the more basic point is that this sort of dispute, concerning the proper construction of Blue Spike's patent claims, should have been resolved through a hearing on claim construction. Such a proceeding would have permitted the patents to be read to have a reasonable scope, rather than destroying them by reading them to be absurdly broad.

D. The Patents-in-Suit Satisfy the Machine-or-Transformation Test.

Another indicator that the Patents-in-Suit teach an inventive concept is that they satisfy the machine-or-transformation test. The Supreme Court recently held that "the machine-or-transformation test is not the sole test" for deciding patent eligibility because it might "deny[] patent protection for inventions in areas not contemplated by Congress." *Bilski*, 561 U.S. at 605 (citing *Diamond v. Chakrabarty*, 447 U.S. 303, 315 (1980)) (marks omitted). Nevertheless, the Court maintained that the "machine-or-transformation test is a useful and important clue, an investigative tool, for determining whether some claimed inventions are processes under § 101." *Id.* at 604. Blue Spike

argued this test to the District Court (*see* A2293-94), but the District Court ignored it entirely. (Appx0001.)

One way for the machine-or-transformation test to be satisfied is if a claim is tied to a particular machine. *In re Bilski*, 545 F.3d 943, 961 (Fed. Cir. 2008) *aff'd but criticized sub nom. Bilski v. Kappos*, 130 S. Ct. 3218 (2010); *Gottschalk v. Benson*, 409 U.S. 63, 69-70 (1972). Many of the claims in the Patents-in-Suit satisfy this aspect. (*See*, *e.g.*, Appx0023, '472 Patent, Claim 11; Appx0038, '700 Patent, Claims 1, 10-12; Appx0052, '494 Patent, Claims 11, 15, 17, 29; Appx0069, '175 Patent, Claims 1, 8, 11, 12, 16, 17; Appx0084, '728 Patent, Claims 25, 26, 30.)

The machine-or-transformation test may also be satisfied if a claim "transforms a particular article into a different state or thing." *Ultramercial*, 772 F.3d at 716. The Signal Abstract—"a key term at issue in every asserted claim" (Appx0008-9)—satisfies this requirement. The Signal Abstract is created by transforming a digital signal into a different thing—a data-reduced representation that is non-invertible while retaining perceptual characteristics of the original signal. (*See*, *e.g.*, Appx0084, '728 Patent, 15:23-27.)

The machine-or-transformation test makes clear that the Patents-in-Suit claim more than simply the abstract concept of "comparing one thing to

another." Blue Spike's patents teach a particular approach to a particular problem—a particular method of comparison based on reducing a digital signal to a particular form that facilitates efficient and accurate analysis. That is sufficient to satisfy § 101.

E. The District Court Inappropriately Conflated Whether the Claims Contain an Inventive Concept with Whether the Individual Claim Limitations are Novel.

In finding that the Patents-in-Suit lacked an inventive concept, the District Court reasoned that such a concept must necessarily represent a novel improvement over prior art, and the Patents-in-Suit lacked such a concept.[21] Any such conclusion would be incorrect, as the Patents-in-Suit extensively discuss how the patents improve on prior art. But the District Court's approach was also legal error for two distinct reasons. First, this Court and the Supreme Court have repeatedly insisted that § 101's requirements for patentable subject matter and § 102's requirement of novelty are analytically distinct. Second, conflating the two is particularly

[21] (*see, e.g.*, Appx0012 ("The claims do not discuss a novel cryptographic method . . . . Thus, the inclusion of this limitation does not constitute an inventive concept."); Appx0013 ("watermarking . . . was in the prior art, and its inclusion here does not constitute an inventive step"); Appx0013 ("The patents do not explain a novel method for generating hashes or digital signatures—they merely call for the use of these conventional cryptographic methods."); Appx0016 ("This approach falls squarely within the prior art and/or the abstract concept discussed above, and introduces no inventive concept.").)

inappropriate in the present context of a motion for judgment on the pleadings. That is because novelty under § 102 inevitably incorporates factual issues concerning the state of the prior art and what a person reasonably skilled in that art would conceive as an improvement. Those issues cannot be resolved on the pleadings alone. By importing its novelty concerns into the § 101 analysis, the District Court deprived Blue Spike of its right to present evidence on the novelty questions.

1. Patentable subject matter and novelty are conceptually distinct.

Although the Supreme Court has recognized that "in evaluating the significance of additional steps, the § 101 patent eligibility inquiry, and say, the § 102 novelty inquiry might sometimes overlap," it has also clearly established "that need not always be so." *Mayo*, 132 S. Ct. at 1303-04. Logically, the two requirements are quite different. Patentability is a permanent aspect of an invention, while novelty is a function of the state of the art at a particular time. The claims in a patent granted a century ago surely would no longer be novel, but that would not mean that the patent did not involve patentable subject matter.

Every innovation entitled to patent protection since the beginning of the United States patent system has relied on the building blocks of the technologies that came before it. *See KSR Intern. Co. v. Teleflex Inc.*, 550

U.S. 398, 418 (2007) ("[I]nventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known."). Any claims directed toward patentable subject matter, of course, must also satisfy § 102's novelty requirement; however, it has never been the case that individual claim limitations must themselves meet the stringent requirements of § 102. Such a position runs counter to the requirement that claims must be analyzed as a whole rather than individually. *See Diehr*, 450 U.S. at 188. Thus, it was error for the District Court to conflate patent-eligibility under Section 101 with the more-stringent patentability requirements under Sections 102, 103, and 112. This conflation confused the applicable standard and turned an otherwise threshold inquiry of patentability into an unduly high hurdle. *See, e.g.*, *Diehr*, 450 U.S. at 190 ("The question therefore of whether a particular invention is novel is wholly apart from whether the invention falls into a category of statutory subject matter." (internal quotation omitted)).

2. Novelty considerations have a factual component and are not properly addressed on a motion for judgment on the pleadings.

Novelty is a function not simply of the patent claims, but of the relationship between those claims and the prior art existing at a particular

point in time. As such, novelty cannot be determined strictly by looking at the terms of the patent; rather, the court must consider evidence concerning the state of the prior art and the contribution that the patent makes to that art. Thus, novelty cannot be evaluated in the context of a Rule 12(c) motion for judgment on the pleadings. By importing novelty considerations into its consideration of patentability under § 101, the District Court inappropriately resolved factual disputes about the prior art.

In support of its motion, Google invited the District Court to make determinations about what were well-understood activities in the prior art even though these determinations cannot have been made on the pleadings alone. (*See* Appx2765, Transcript at 27:7-9 ("There's no description of what it means to be a cryptographic technique because it is a well-understood practice in the art.").) Whether the cryptographic techniques involved in Blue Spike's patents were well-understood, routine, or conventional activities at the relevant time (the date of filing) is a fact-intensive and disputed question. Its resolution would require underlying determinations of at least (1) the level of skill of a person having ordinary skill in the art, (2) factual determinations about what techniques were not merely known but also "conventional," and (3) how a person having ordinary skill in the art at the time of filing would have understood the terms of the asserted claims.

Blue Spike submits that, even if it were permissible to look beyond the pleadings on a Rule 12(c) motion, the record did not contain sufficient facts to resolve the disputed novelty issues. Google bore the burden to establish that the claim limitations and technologies encompassed by the Patents-in-Suit were well-understood and conventional, and the District Court was obliged to resolve any factual ambiguities in Blue Spike's favor. Even if it had been appropriate to introduce issues of novelty into the § 101 determination, then, the District Court could not validly have resolved those issues in the way that it did.

For example, regarding the "cryptographic protocol" claim limitation of Claim 10 of the '700 Patent, the District Court opined without discussion or analysis that, "The claims do not discuss a novel cryptographic method, but merely contemplate '"well-understood, routine, conventional activity.'" (Appx00012.) Whether the cryptographic protocol contemplated by the claimed invention is novel and to what extent it would have been considered well-understood, routine, and conventional activity to a heretofore undefined person having ordinary skill in the art is a highly factual question. Thus, the District Court erred in finding that this claim limitation could not have supplied the inventive concept with respect to this asserted claim.

3. An inventive concept can exist even though it takes into account methods and techniques known in the prior art.

In rejecting all remaining claim limitations of the asserted claims, the District Court's analysis focused on the presence of conventional and routine computing methods. (*See, e.g.*, Appx0010 (discussing use of "general purpose computer components"); Appx0012 (reasoning use of a cryptographic protocol is "well-understood, routine, conventional activity).) However, the Court construed conventional and routine activity as methods and techniques known in the prior art, adopting Google's argument that because the patentee did not invent the individual claim limitations, they were ineligible to form the inventive concept of the asserted claims.[22] Further, in conflating the novelty requirements with the search for an inventive concept under step two of the *Alice/Mayo* inquiry, the District Court ignored the rule that non-novel claim limitations – individually and/or

[22] At the hearing on Google's § 101 Motion, Google argued that prior art methods—those not invented by the patentees—cannot serve as the basis for an inventive concept and invited the District Court to find that "well understood and conventional" is synonymous with prior art. (*See* Appx2764, Transcript at 26:14-18 ("So I want to go through the particular limitations that are raised and show where those things either have been held to be or are admitted to be essentially well understood routine and conventional—i.e., practiced by others and not invented by the patent—the inventors."); Appx2767, Transcript at 29:9-12 ("They certainly don't say that they're inventing spectral transforms.").)

as an ordered combination—may nonetheless form the basis for an inventive concept.

In *Diehr*, the Supreme Court expressly rejected the "point of novelty" approach the District Court applied here. The Court stated that, in "determining the eligibility of [the patentees'] claimed process for patent protection under § 101, their claims must be considered as a whole." 450 U.S. at 188. "It is inappropriate to dissect the claims into old and new elements and then to ignore the presence of the old elements in the analysis." *Id.* The Court explained that "[t]he *'novelty' of any element or steps* in a process . . . *is of no relevance* in determining whether the subject matter of a claim falls within the § 101 categories of possibly patentable subject matter." *Id.* at 188-89 (emphasis added). The District Court here did precisely what *Diehr* prohibits—it dissected the claims "into old and new elements" and focused solely on the "point of novelty" in determining whether the claims' subject matter is patent-eligible in the first instance.

The District Court also fatally misconstrued the *scope* of the "conventional activity" exclusion. *Mayo* explains that "well-understood, routine, conventional activity" may not suffice to "transform an unpatentable law of nature into a patent-eligible application of such a law." 132 S. Ct. at 1298. The District Court, however, interpreted that to mean that *any step*

with a basis in the prior art must be disregarded. (*See* Appx0011-18.) As one judge noted in criticizing another district court opinion containing similar reasoning, "neither *Mayo* nor any other precedent defines conventional elements to include *everything* found in prior art." *Cal. Institute of Tech. v. Hughes Communications Inc.*, 59 F. Supp. 3d 974, 989 (C.D. Cal. 2014).

F. The District Court Erred By Failing to Assess the Claims as a Whole.

In assessing the dependent claims of the Patents-in-Suit, the District Court failed to consider the dependent claim elements individually and "as an ordered combination." *Alice*, 134 S. Ct. at 2359. Unlike the Court's analysis in *Alice*, here, the District Court only conducted a cursory analysis of the individual claim limitations (which suffer from other defects as outlined above), failing to consider whether the claim limitations in concert reveal an inventive concept. In *Alice*, the Court opined that the generic computer components of the claimed method "ad[d] nothing . . . that is not already present when the steps are considered separately," and when viewed as a whole, the claimed method "amount to 'nothing significantly more' than an instruction to apply the abstract idea of intermediated settlement using some unspecified, generic computer." *Alice*, 134 S. Ct. at 2359-60 (citing

Mayo, 132 S. Ct. at 1298). *Alice* makes clear that courts must view claim limitations together in search of an inventive concept.[23]

The District Court's analysis of the dependent claims was limited to assessing the claims in isolation, looking only to whether the dependent claims standing along contained an "inventive concept." This analysis was faulty because the District Court failed to consider whether the claim limitations as an ordered combination reveal an inventive concept. *See Digitech Image Techs, LLC v. Electronics for Imaging, Inc.*, 758 F.3d 1344, 1350 (Fed. Cir. 2014) (noting that "[i]n determining whether a process claim recites an abstract idea, we must examine the claim as a whole"). Claim 10 of the '700 Patent illustrates the importance of examining claims as a whole. The District Court considered Claim 10's reference to a digital signature or hash as routine, but it failed to consider whether a digital signature or hash in combination with a Signal Abstract might itself be inventive. Claim 10 combines the benefits of a Signal Abstract such as "massive data reduction" with "cryptographic techniques," such as a hash or digital signature "to further add accuracy and confidence in the system." (Appx0038, '700

[23] *See also Diehr*, 450 U.S. at 188 ("In determining the eligibility of respondents' claimed process for patent protection under § 101, their claims must be considered as a whole. It is inappropriate to dissect the claims into old and new elements and then to ignore the presence of the old elements in the analysis.").

Patent, 10:39-49.) Even if the cryptographic method contemplated in Claim 10 were routine by itself, its combination with the Signal Abstract is an inventive concept. The District Court erred by failing to analyze the claims, including Claim 10, as a whole.

III. THE DISTRICT COURT IMPROPERLY IMPORTED CONCERNS ABOUT NOVELTY, NON-OBVIOUSNESS, AND DESCRIPTIVE ENABLEMENT INTO THE § 101 INQUIRY.

The Supreme Court noted in *Bilski* that "[t]he § 101 patent-eligibility inquiry is only a threshold test"; even if that test is satisfied, "the claimed invention must also satisfy 'the conditions and requirements of this title,'" including "that the invention be novel, *see* § 102, nonobvious, *see* § 103, and fully and particularly described, *see* § 112." 561 U.S. at 602 (quoting 35 U.S.C. § 101). The District Court in this case plainly harbored doubts about not only the novelty of Blue Spike's technology, but also these additional requirements. In particular, it expressed doubt concerning whether the Patents-in-Suit adequately specified and enabled the actual invention. (*See* Appx2757, Transcript at 19:8-12 ("I'm asking you to explain the patent. Does it do anything other than tell the reader to identify something that a human perceives and compare it to something else through the use of a computer? Does it do anything other than that?"); Appx2774, 36:21-22 ("This patent doesn't disclose or teach those compression techniques.");

Appx2775, 37:4-10 ("[W]hy would I have an entire case be litigated where on the face of the patent, there's nothing there?").) Google did not move for judgment on these grounds, however—nor could it have, as these issues, like novelty, are fact-intensive and disputed, and thus could not be resolved in a judgment on the pleadings. Instead, Google's claim that Blue Spike had not actually invented anything infected the District Court's analysis of patent eligibility under § 101.

This was error. As Justice Stevens noted in *Bilski*, "claim specification is covered by § 112, not § 101; and if a series of steps constituted an unpatentable idea merely because it was described without sufficient specificity, the Court could be calling into question some of our own prior decisions." 561 U.S. at 620 (Stevens, J., concurring in the judgment). By making factual judgments relating to the § 112 issues as part of its § 101 analysis, the District Court violated the narrow parameters of Rule 12(c).

The Supreme Court has not addressed the propriety of resolving a § 101 eligibility challenge at the pleading stage. *Alice* and *Mayo* were both summary judgment cases, *see Alice*, 134 S. Ct. at 2353; *Mayo*, 132 S. Ct. at 1296, and *Bilski* was an appeal from the USPTO's denial of a patent

application, *see* 561 U.S. at 599-600. It is unclear how any district court can determine the boundary between non-inventive claim limitations and claim limitations, which confer patent-eligibility without reliance on extrinsic evidence. But this Court need not categorically resolve this issue in the present case. Whether or not courts may resolve eligibility issues on the pleadings in some cases, they plainly may not do so where eligibility does in fact turn on materials outside the pleadings or on disputed matters of fact. *See Chavez v. United States*, 683 F.3d 1102, 1108 (9th Cir. 2012) (observing that, on a motion for judgment on the pleadings, "[a] court generally cannot consider material outside of the complaint (*e.g.*, facts presented in briefs, affidavits or discovery materials)"). The District Court here was thus obligated either to confine its analysis to the pleadings or to deny Google's motion.

Nonetheless, the District Court here looked at practices, customs, and conventions outside of anything alleged in the complaint or the Patents-in-Suit. The pleadings and Patents-in-Suit include insufficient facts to have determined, for example, that hashes and digital signatures are "conventional cryptographic methods." (Appx0013.) Google's motion extensively discussed § 112 issues, and these improperly raised concerns seem to have infiltrated the District Court's opinion of the asserted claims. During oral

argument, the district judge repeatedly cast doubt on the merit of the claimed inventions, not through the lens of subject-matter eligibility but rather through the apparent lens of enablement. When discussing the parallels between the asserted claims and artificial intelligence, which seeks to model human behavior, the District Court judge stated, "Well, in that context, haven't . . . scientists actually generated the method by which the perceptions you're seeking to compare could actually be digitized, which you in this patent certainly do not do. . . . I mean, I don't . . . understand how you can compare what this patent seeks to achieve with something as complicated as this given that all you're saying is take what everybody else has done and compare them." (Appx2774, Transcript at 36:3-10.) Statements like this reflect a qualitative judgment about whether the asserted claims are sufficiently enabled and otherwise meet the requirements of § 112.

Ultimately, the District Court ignored a number of claim limitations containing an inventive concept because, in its estimation, they failed to meet the requirements of § 112. Regarding claim 26 of the '728 Patent, the court opined that "the patent does nothing to teach a person having ordinary skill in the art how to perform a spectral transform," and concluded that spectral transforms must "be well understood at the time the patent was filed." (*See* Appx0018.) This reasoning relies on a factual determination of

who a person having ordinary skill in the art is and whether spectral transforms were well understood at the time the patents were filed.[24]

The requirements of § 112 should be and are irrelevant to the § 101 analysis. Title 35 sets the § 112 written description and enablement requirements for patentability "wholly apart from whether the invention falls into a category of statutory subject matter." *Diehr*, 450 U.S. at 190. As former Chief Judge Rader noted, "the 'coarse eligibility filter' of § 101 should not be used to invalidate patents based on concerns about vagueness, indefinite disclosure, or lack of enablement, as these infirmities are expressly addressed by § 112." *Ultramercial, LLC v. Hulu, LLC*, 657 F.3d 1323, 1329 (Fed. Cir. 2011), *cert. granted*, *judgment vacated sub nom. WildTangent, Inc. v. Ultramercial, LLC*, 132 S. Ct. 2431 (2012).[25] The proper course would have been to deny the Rule 12(c) motion on eligibility and litigate the § 112 issues on summary judgment or at trial. Because the

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[24] The District Court further ignored the possibility that technological solutions known in the prior art may nonetheless not qualify as routine, conventional, or even well-understood by a person having ordinary skill in the art at the date of filing.

[25] *See also Research Corp. Techs., Inc. v. Microsoft Corp.*, 627 F.3d 859, 869 (Fed. Cir. 2010) ("In section 112, the Patent Act provides powerful tools to weed out claims that may present a vague or indefinite disclosure of the invention.").

District Court failed to do this, its decision should be reversed and remanded for further development and decision of these disputed factual matters.

CONCLUSION

The District Court's judgment should be reversed.

Dated: January 6, 2016

Respectfully submitted,

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ADDENDUM

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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

BLUE SPIKE, LLC, Plaintiff, v. **GOOGLE INC.** Defendant.	Case No. 14-cv-01650-YGR **ORDER GRANTING MOTION FOR JUDGMENT ON THE PLEADINGS** Re: Dkt. No. 59

Defendant Google Inc. ("Google") moves for judgment on the pleadings, arguing the asserted claims of the patents-in-suit—which broadly cover computer-based content comparisons—are invalid as embodying an unpatentable "abstract idea" under Section 101 of the Patent Act. (Dkt. No. 59 ("Mot.").) Plaintiff Blue Spike, LLC ("Blue Spike") opposes the motion. (Dkt. No. 63 ("Oppo.").) Having carefully considered the papers submitted, the patents-in-suit, the record in this case, and the arguments of counsel at the June 30, 2015 hearing, and good cause shown, the Court **GRANTS** the motion.

I. BACKGROUND

The plaintiff asserts five patents in this lawsuit: U.S. Patent Nos. 7,346,472 (the "'472 Patent"), 7,660,700 (the "'700 Patent"), 7,949,494 (the "'494 Patent"), 8,214,175 (the "'175 Patent"), and 8,712,728 (the "'728 Patent").[1] Other than the first, each is a continuation of the

[1] The plaintiff filed copies of each patent as attachments to its initial complaint. (Dkt. No. 1.) The defendant filed additional copies, with the asserted claims highlighted, as exhibits to the instant motion. (Dkt. No. 60.) The asserted claims are as follows: 1-4, 8, and 11 of the '472 Patent; 1, 10-12, 18, 21, 27, 40, and 51 of the '700 Patent; 11, 15, 17, and 29 of the '494 Patent; 1, 8, 11, 12, 16, and 17 of the '175 Patent; and 1, 4, 5, 16, 25, and 26 of the '728 Patent. (*See* Mot. at 4; Oppo. at 3 n.2.) The parties dispute whether claim 30 of the '728 Patent remains at issue. However, as the motion was not directed to that claim, neither is this Order. (*See* Oppo. at 3 n.2; Dkt. No. 64 ("Reply") at 15 n.9.)

preceding application. All five are entitled "Method and Device for Monitoring and Analyzing Signals" and share the same specification. The patents include both method and system claims. Generally, the patents address the creation of "abstracts" (essentially digital fingerprints, hashes, or the like) from various "signals" (electronic versions of human-perceptible works in formats such as audio, visual, audiovisual, or text) based on perceptible qualities inherent to those signals.[2] The abstracts of "reference signals" are added to a reference database. Thereafter, new signals ("query signals") can be similarly processed, the resulting abstract checked against the database to determine whether the new signal matches any earlier analyzed signal. At a high level, the patents contemplate determining whether one piece of content—e.g., a picture, a song, or a video—matches another, or the extent to which they are similar. The plaintiff accuses Google's "products, systems and/or services," including ContentID and YouTube, of infringement. (Dkt. No. 47 ("FAC") ¶ 28.) The plaintiff also contends the patents cover a wide array of comparison technologies, including biometric systems such as iris scanners. (*See* Oppo. at 20.)

The Court finds that claim 1 of the '472 Patent is generally representative of all asserted claims for purposes of this motion.[3] It reads as follows:

> A method for monitoring and analyzing at least one signal comprising:
>
> > receiving at least one reference signal to be monitored;
> >
> > creating an abstract of said at least one reference signal wherein the step of creating an abstract of said at least one

---

[2] The specification contrasts this approach of relying on perceptual qualities inherent in the signal with what it calls the "traditional" or prior art approach of employing an "additive signal" (e.g., adding something to the signal, such as a title or watermark, to facilitate future identification and comparison). *See* '728 Patent at 4:53-55, 4:66-5:4, 5:15-25.

[3] Plaintiff did not stipulate to the use of this or any other representative claim(s) for purposes of this motion. Therefore, the Court must consider every claim at issue. Nevertheless, because 31 claims spanning five patents are asserted, and in light of the fact that each is "substantially similar and linked to the same abstract idea," the Court finds the following approach to resolving this motion justified: addressing first, in detail, a single, broadly representative claim (claim 1 of the '472 Patent), and then explaining briefly why any material distinctions or additional limitations in each of the other claims are irrelevant to the ultimate conclusion of invalidity. *See Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat. Ass'n*, 776 F.3d 1343, 1348 (Fed. Cir. 2014); *see also Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 709 (Fed. Cir. 2014).

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> reference signal comprises:
>
> > inputting the reference signal to a processor;
> >
> > creating an abstract of the reference signal using perceptual qualities of the reference signal such that the abstract retains a perceptual relationship to the reference signal from which it is derived;
>
> storing the abstract of said at least one reference signal in a reference database;
>
> receiving at least one query signal to be analyzed;
>
> creating an abstract of said at least one query signal wherein the step of creating an abstract of said at least one query signal comprises:
>
> > inputting the at least one query signal to the processor;
> >
> > creating an abstract of the at least one query signal using perceptual qualities of the at least one query signal such that the abstract retains a perceptual relationship to the at least one query signal from which it is derived; and
>
> comparing the abstract of said at least one query signal to the abstract of said at least one reference signal to determine if the abstract of said at least one query signal matches the abstract of said at feast [*sic*][4] one reference signal.

’472 Patent at 15:33-60.

In its opposition brief, Blue Spike argued claim construction was needed prior to resolution of Google’s motion, suggesting the claim constructions previously issued by the Eastern District of Texas involving four of the five patents at issue should be adopted. *See Blue Spike, LLC v.*

[4] This is an obvious typographical error. While the parties have not raised the issue of whether this is an error, the Court assumes for purposes of ruling on this this motion that the ’472 Patent should read “least” instead of “feast.” The Court may only correct an obvious typographical error when, from the perspective of a person of ordinary skill in the art, “(1) the correction is not subject to reasonable debate based on consideration of the claim language and the specification and (2) the prosecution history does not suggest a different interpretation of the claims.” *Ultimax Cement Mfg. Corp. v. CTS Cement Mfg. Corp*., 587 F.3d 1339, 1352-53 (Fed. Cir. 2009) (citing *Novo Industries, L.P. v. Micro Molds Corp.*, 350 F.3d 1348, 1354 (Fed. Cir. 2003)). The Court therefore corrects this obvious typographical error for purposes of this motion, substituting “least” for “feast.” *See Ultimax*, 587 F.3d at 1353 (reversing district court’s finding of claim indefiniteness where the district court should have instead inserted a missing comma into a chemical formula in a claim because a person of ordinary skill would have recognized and fixed the error).

Texas Instruments, Inc., No. 6:12-CV-499-MHS-CMC, 2014 WL 5299320, at *4 (E.D. Tex. Oct. 16, 2014) ("Prior Construction"). At the hearing, Google stipulated to the adoption of those constructions solely for purposes of resolving its motion for judgment on the pleadings.[5] Most critically in terms of the plaintiff's argument, the Texas court construed "abstract" as "a data-reduced representation of a signal that retains a perceptual relationship with the signal and differentiates the data-reduced representation from other data-reduced representations." (*Id*. at *14.)

The Court further notes that the specification does not teach the specifics of implementation—it includes no source code, detailed algorithms or formulas, or the like.

II. LEGAL STANDARD

Under Federal Rule of Civil Procedure 12(c), judgment on the pleadings may be granted when, accepting as true all material allegations contained in the nonmoving party's pleadings, the moving party is entitled to judgment as a matter of law. *Chavez v. United States*, 683 F.3d 1102, 1108 (9th Cir. 2012). The applicable standard is essentially identical to the standard for a motion to dismiss under Rule 12(b)(6). *United States ex rel. Cafasso v. Gen. Dynamics C4 Sys., Inc.*, 637 F.3d 1047, 1054 n.4 (9th Cir. 2011). Thus, although the Court must accept well-pleaded facts as true, it is not required to accept mere conclusory allegations or conclusions of law. *See Ashcroft v. Iqbal*, 556 U.S. 662, 678–79 (2009).

In ruling on a motion for judgment on the pleadings, the Court "need not . . . accept as true allegations that contradict matters properly subject to judicial notice or by exhibit" attached to the complaint. *Sprewell v. Golden State Warriors*, 266 F.3d 979, 988 (9th Cir. 2001) (citation omitted). A challenge under Section 101 of the Patent Act may be brought as a motion for judgment on the pleadings. *See Open Text S.A. v. Box, Inc.*, No. 13-CV-04910-JD, 2015 WL 269036, at *2 (N.D. Cal. Jan. 20, 2015) (citing *buySAFE, Inc. v. Google, Inc.*, 765 F.3d 1350,

[5] The parties have not argued that different constructions should apply to the most recent continuation patent. The Court sees no reason to depart from the Prior Construction in the case of the '728 Patent in light of the similarity of all five patents at issue, which, as noted above, share the same specification.

1352 (Fed. Cir. 2014)). A court may decide such a motion prior to claim construction. *See Bancorp Servs., L.L.C. v. Sun Life Assur. Co. of Canada (U.S.)*, 687 F.3d 1266, 1273-74 (Fed. Cir. 2012) ("[C]laim construction is not an inviolable prerequisite to a validity determination under § 101. We note, however, that it will ordinarily be desirable—and often necessary—to resolve claim construction disputes prior to a § 101 analysis, for the determination of patent eligibility requires a full understanding of the basic character of the claimed subject matter.").

III. DISCUSSION

A. Legal Framework

The scope of subject matter eligible for patent protection is defined in Section 101 of the Patent Act: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. § 101. The Supreme Court has "long held that this provision contains an important implicit exception: Laws of nature, natural phenomena, and abstract ideas are not patentable." *Alice Corp. Pty. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2354 (2014) ("*Alice*") (quoting *Ass'n for Molecular Pathology v. Myriad Genetics, Inc.*, 133 S. Ct. 2107, 2116 (2013)). In applying this exception, courts "must distinguish between patents that claim the building blocks of human ingenuity and those that integrate the building blocks into something more." *Alice*, 134 S. Ct. at 2354 (internal quotations and alterations omitted); *see also Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 132 S. Ct. 1289, 1301 (2012).

Thus, in determining whether claims are patent-ineligible, a court must first determine whether they are directed to a patent-ineligible concept, such as an abstract idea. *See Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980). "A principle, in the abstract, is a fundamental truth . . . [which] cannot be patented." *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972) (internal citations and quotations omitted). "Phenomena of nature, though just discovered, mental processes, and abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work." *Id.*; *see also CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1371 (Fed. Cir. 2011) ("[M]ental processes are not patent-eligible subject matter because the 'application of [only] human intelligence to the solution of practical problems is no more than a

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claim to a fundamental principle.'"). To determine whether patent claims are directed to an abstract idea, the Court must "distill[] the gist of the claim[s]." *Open Text S.A*, 2015 WL 269036, at *2 (citing *Bilski v. Kappos*, 561 U.S. 593, 611-12 (2010)).

If the claims are directed to an abstract idea, a court must then consider whether they nevertheless involve an "inventive concept" such that "the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself." *Alice*, 134 S. Ct. at 2355 (quoting *Mayo*, 132 S. Ct. at 1294); *see also DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1255 (Fed. Cir. 2014) ("Distinguishing between claims that recite a patent-eligible invention and claims that add too little to a patent-ineligible abstract concept can be difficult, as the line separating the two is not always clear."). "For the role of a computer in a computer-implemented invention to be deemed meaningful in the context of this analysis, it must involve more than performance of 'well-understood, routine, [and] conventional activities previously known to the industry.'" *Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat. Ass'n*, 776 F.3d 1343, 1347-48 (Fed. Cir. 2014) (alteration in original); *see also buySAFE, Inc. v. Google, Inc.*, 765 F.3d 1350, 1354 (Fed. Cir. 2014) ("The Court in *Alice* made clear that a claim directed to an abstract idea does not move into section 101 eligibility territory by 'merely requir[ing] generic computer implementation.'") (alteration in original).

The burden of establishing invalidity rests on the movant. *See Microsoft Corp. v. i4i Ltd. P'ship*, 131 S. Ct. 2238, 2245 (2011) (citing 35 U.S.C.A. § 282). However, on a motion for judgment on the pleadings for invalidity, where no extrinsic evidence is considered, the "clear and convincing" standard for weighing evidence in determining a patent's validity is inapplicable. *See Shortridge v. Found. Constr. Payroll Serv.*, LLC, No. 14-CV-04850-JCS, 2015 WL 1739256, at *7 (N.D. Cal. Apr. 14, 2015) (citing *Modern Telecom Sys. LLC v. Earthlink, Inc.*, No. 14-CV-0347-DOC, 2015 WL 1239992, at *8 (C.D. Cal. Mar. 17, 2015)).

After *Alice*, the Federal Circuit has held a number of patent claims directed to abstract ideas to be invalid. A sampling follows:

- "[D]igital image processing" claims were directed to "an abstract idea because [they described] a process of organizing information through mathematical

correlations and [were] not tied to a specific structure or machine." *Digitech Image Technologies, LLC v. Electronics for Imaging, Inc.*, 758 F.3d 1344, 1347, 1350 (Fed. Cir. 2014).

- Claims covering "methods and machine-readable media encoded to perform steps for guaranteeing a party's performance of its online transaction" were merely "directed to creating familiar commercial arrangements by use of computers and networks." *buySAFE, Inc. v. Google, Inc.*, 765 F.3d 1350, 1351 (Fed. Cir. 2014).
- Patent "directed to a method for distributing copyrighted media products over the Internet where the consumer receives a copyrighted media product at no cost in exchange for viewing an advertisement" was directed to an abstract idea, and "routine additional steps such as updating an activity log, requiring a request from the consumer to view the ad, restrictions on public access, and use of the Internet [did] not transform [the] otherwise abstract idea into patent-eligible subject matter." *Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 709, 716 (Fed. Cir. 2014).
- Patents covering a method for optical character recognition in connection with scanning hard copy documents were directed to an abstract idea and, even if limited "to a particular technological environment," were invalid because "[s]uch a limitation has been held insufficient to save a claim in this context." *Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat. Ass'n*, 776 F.3d 1343, 1348 (Fed. Cir. 2014).
- Patent relating to a "method of price optimization in an e-commerce environment . . . claims no more than an abstract idea coupled with routine data-gathering steps and conventional computer activity . . . ." *OIP Technologies, Inc. v. Amazon.com, Inc.*, 788 F.3d 1359, 1360 (Fed. Cir. 2015).
- Claims directed to "tracking financial transactions to determine whether they exceed a pre-set spending limit (i.e., budgeting)" covered "an abstract idea and [did] not otherwise claim an inventive concept." *Intellectual Ventures I LLC v. Capital One Bank (USA)*, 792 F.3d 1363, 1367, 1370 (Fed. Cir. 2015).

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Notably, however, in *DDR Holdings, LLC v. Hotels.com, L.P.*, the Federal Circuit upheld a finding of validity as to a patent with claims "directed to systems and methods of generating a composite web page that combines certain visual elements of a 'host' website with content of a third-party merchant." 773 F.3d 1245, 1248 (Fed. Cir. 2014) ("For example, the generated composite web page may combine the logo, background color, and fonts of the host website with product information from the merchant."). The Federal Circuit found the patent "address[es] a business challenge (retaining website visitors) . . . particular to the Internet," but cautioned "that not all claims purporting to address Internet-centric challenges are eligible for patent." *Id.* at 1257-59.

B. Analysis

1. Abstract Idea

As a threshold matter, the Court must determine whether the asserted claims are directed to an abstract idea. The Court finds that the claims at issue are generally directed to the abstract concept of comparing one thing to another.

The patents seek to "model," on a computer, "the highly effective ability of humans to identify and recognize a signal." (*See* '728 Patent at 4:47-48.) By their own terms, therefore, the patents simply seek to cover a general purpose computer implementation of an abstract idea long undertaken within the human mind. *See Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat. Ass'n*, 776 F.3d 1343, 1347 (Fed. Cir. 2014) ("The concept of data collection, recognition, and storage is undisputedly well-known. Indeed, humans have always performed these functions."). Despite the opinion of plaintiff's expert, on their face the patents do not purport to recognize aspects of the compared works that only a computer—but not a human—could reasonably detect. The specification itself emphasizes the goal of modeling human capacity. Nothing in the claim language suggests the patents were not intended to encompass computerized content comparisons based on human-perceptible characteristics. To the contrary, the Prior Construction of "abstract" (a key term at issue in every asserted claim) states that the abstract has a "perceptual relationship" to the signal, and the Prior Construction for related terms reveals the

patents are generally directed to human-observable aspects of signals.[6]

The method by which the claims contemplate enabling these comparisons mirrors the manner in which the human mind undertakes the same task. Perceptible characteristics of an item (e.g., a photograph) are used as a heuristic to compare that item to others. For instance, to borrow an example from the specification, one might compare paintings of sunsets by focusing on "perceptual characteristics related to the sun," e.g., its color or position. '728 Patent at 14:52-60; *see also id.* ("The present invention . . . involves the scanning of an image involving a sun, compressing the data to its essential characteristics (i.e., those perceptual characteristics related to the sun) and then finding matches in a database of other visual images (stored as compressed or even uncompressed data). By studying the work of other artists using such techniques, a novice, for example, could learn much by comparing the presentations of a common theme by different artists."). One might also identify a criminal by comparing a police artist sketch to various suspect photographs. *Id*. at 14:61-64. True, certain asserted claims involve only a subset of the mental process—e.g., creating the "abstract," but not necessarily using it for anything. That these claims cover only a part of the broader abstract idea does not rescue them from falling within the realm of the abstract.

Blue Spike argues, with the support of an expert declaration, that its claims cover an invention that can accomplish comparisons beyond a human's capabilities. (*See* Papakonstantinou Decl., Dkt. No. 63-11, at ¶¶ 13-17 (opining that the creation of an abstract as contemplated in the patents-in-suit "requires use of a computing device configured to utilize data-reduction techniques" which a human "would not be capable" of mentally performing, particularly where "accuracy (down to even a single bit) . . . is essential").) Even if credited, this premise is legally false; the claims may be abstract even if they contemplate use of "a computer that processe[s] streams of bits." *See Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat. Ass'n,*

[6] For instance, pursuant to the stipulation of the parties in that case, including plaintiff Blue Spike, the order construed "perceptual quality" as being a "quality *perceived by a person*" and "recognizable characteristic" as a "characteristic visually or aurally *perceived by a person*." *See* Prior Construction at *30 (emphasis supplied).

776 F.3d 1343, 1347 (Fed. Cir. 2014) (citing *Alice*, 134 S. Ct. at 2358).

Blue Spike further disputes Google's contention that a patent that seeks to mirror human perception and analysis on a computer is abstract with a "slippery slope" argument, contending such a finding would also render future breakthroughs in artificial intelligence technology un-patentable. To the extent artificial intelligence inventions—or the present "invention"—involve an inventive concept, they could be patentable even if they have, at their core, an abstract concept. The Court thus turns to the question of whether the asserted claims include an inventive concept.

2. Inventive Concept

As noted, the patents are directed to an abstract idea—the idea of comparing one thing to another. Blue Spike contends the claims would cover a nearly limitless scope of signals for comparison—ranging from irises to songs. However, the claims do not involve any "inventive concept." *See Alice*, 134 S. Ct. at 2355. Instead, they merely discuss using routine computer components and methods (e.g., general purpose computers, compression, and databases) to accomplish this task with, in certain circumstances, greater efficiency than a human mind could achieve. *See Kroy IP Holdings, LLC v. Safeway, Inc.*, No. 2:12-CV-800-WCB, 2015 WL 3452469, at *13 (E.D. Tex. May 29, 2015) ("The greater efficiency with which the computer can perform tasks that a human could perform does not render the inventions patentable."); *Bancorp Services, L.L.C. v. Sun Life Assur. Co. of Canada (U.S.)*, 687 F.3d 1266, 1278 (Fed. Cir. 2012) ("[T]he use of a computer in an otherwise patent-ineligible process for no more than its most basic function—making calculations or computations—fails to circumvent the prohibition against patenting abstract ideas and mental processes."). Merely adding limitations involving the use of general purpose computer components to an otherwise abstract concept does not constitute an inventive concept sufficient to save a claim from invalidity. *See Planet Bingo, LLC v. VKGS LLC*, 576 F. App'x 1005, 1008 (Fed. Cir. 2014) (finding claims lacked an "inventive concept," despite being limited to computer-aided methods and systems, where the steps at issue could be "carried out in existing computers long in use" and "done mentally") (quoting *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972)). The mere fact that the claims may cover a computer implementation that surpasses in scope or complexity what a human mind is capable of accomplishing is irrelevant

where the claims are not limited to such complex activities, but also encompass more basic approaches. *Id.* Here, to the extent the asserted claims do encompass comparisons that a human is not readily capable of undertaking—an argument belied by the specification—they nevertheless *also* cover and preempt a wide range of comparisons that humans can and, indeed, have undertaken from time immemorial. Accordingly, given the patents claim an abstract idea but lack any inventive concept, they fail to meet the legal standard for patentability.

3. Additional Claims

The foregoing two-step analysis, largely focused on claim 1 of the ’472 Patent, applies with equal force to all claims at issue. The only material distinctions, e.g., inclusion of generic computer components, do not save those claims from invalidity. *See, e.g., Cogent Med., Inc. v. Elsevier Inc.*, 70 F. Supp. 3d 1058, 1066 (N.D. Cal. 2014) (finding certain “system and computer component claims rise and fall with the method claims” where they merely involve “generic computer components configured to implement the [abstract] idea”). The Court addresses each of the remaining claims in turn:

a. ’472 Patent

- **Claim 2** is a dependent claim, taking the method of claim 1 (the representative claim) but generating abstracts of only portions of signals, instead of signals in their entirety. The claim still encompasses the abstract idea discussed above and this limitation does not constitute an inventive concept.
- **Claim 3** covers largely the same ground as the representative claim, but includes incremental counting steps—namely, a method for tracking the number of matches detected by the comparison process. This basic computer-based counting fails to rescue the claim from the realm of the abstract. *See Ultramercial, Inc.*, 772 F.3d at 712, 715 (characterizing a step of “recording [a] transaction event to [an] activity log, . . . including updating the total number of times” the event has occurred, as “routine, conventional activity”).
- **Claim 4** is dependent on claim 3 and merely adds routine steps for recording each match and generating a report identifying the matched signals. *See Alice*, 134 S.

Ct. at 2359 (mere "use of a computer to create electronic records, track multiple transactions, and issue simultaneous instructions" does not constitute an inventive concept).

- **Claim 8** mirrors, in substance, the representative claim, with the further limitation—immaterial to this analysis—that more than one reference signal is used, and also including an incremental counter for matches.
- **Claim 11** is a system claim, involving generic computer components and routines ("a computerized system," "a processor," "a reference database," and "input[s]") to accomplish the basic method of the representative claim. Unlike the earlier discussed claims, this claim is not limited to detecting an exact "match," but instead compares the two abstracts to generate "an index of relatedness." The abstract idea discussed above is "comparison"—whether to find exact matches, or to determine the extent of similarity. Further, as noted, a system claim that merely incorporates generic computer components to implement the abstract idea of the method claim fails along with the method claim. Finally, the limitation of selecting certain criteria to consider in comparing things falls squarely within the heuristic approach the human mind takes to solving the same problem. It therefore does not rescue the claim from abstraction, nor does it constitute an inventive concept.

b. '700 Patent

- **Claim 1** covers "[a]n electronic system," similar to claim 11 of the '472 patent, but limited to matching instead of broader comparisons. It similarly fails.
- **Claim 10** depends on claim 1, but includes the limitation that "a cryptographic protocol" is applied to one or more of the abstracts at issue. The claims do not discuss a novel cryptographic method, but merely contemplate "'well-understood, routine, conventional activity.'" *See Intellectual Ventures II LLC v. JP Morgan Chase & Co.*, No. 13-CV-3777 AKH, 2015 WL 1941331, at *14 (S.D.N.Y. Apr. 28, 2015) (citing *Mayo*, 132 S. Ct. at 1298). Thus, the inclusion of this limitation does not constitute an inventive concept.

- **Claim 11** depends on claim 10, but is further limited to the use of a cryptographic protocol that has "at least a hash or digital signature," and the storage of the encrypted abstract. The patents do not explain a novel method for generating hashes or digital signatures—they merely call for the use of these conventional cryptographic methods.
- **Claim 12** depends on claim 1, but adds "an embedder to embed uniquely identifiable data into at least one" of the signals. As the specification itself notes, however, such watermarking (or use of "additive signals") was in the prior art, and its inclusion here does not constitute an inventive concept. *See, e.g.*, '700 Patent at 4:44-53, 13:37-40 ("Traditionally, monitoring is accomplished by *embedding* some *identifier* into the signal, or affixing the identifier to the signal, for later analysis and determination of royalty payments.") (emphasis supplied).
- **Claim 18** is a method claim, apparently for a digital rights management ("DRM") or other routine data transmission system. The claim notes the match determination is undertaken "to enable authorized transmission or use of the query signal." As to the data transmission issue, the claim does no more than present this basic recitation of purpose, but does not present an inventive method to facilitate data transmission. The claim is otherwise similar to the representative claim, but is further limited to generation of abstracts based on "signal characteristic parameters configured to differentiate between a plurality of versions of the data signal." This is not a unique approach; indeed, as noted above, humans also focus on discrete characteristics to facilitate comparisons between two similar things, e.g., paintings of sunsets. These additional limitations do not save the claim.
- **Claim 21** is dependent on claim 18, but limited to abstracts "derived from one of a cognitive feature or a perceptible characteristic" of the signals. This broad "limitation" (covering use of *any* aspect of a signal that a human could perceive) is not meaningful for purposes of the preceding analysis.
- **Claim 27** is dependent on claim 18, but involves comparison instead of matching.

As noted above, this is a distinction without a difference in regards to the claim's validity.

- **Claim 40** covers a process similar to the representative claim, but again is focused on certain parameters and directed to similarity comparison instead of direct matching.
- **Claim 51** is dependent on claim 40, but includes an additional step: "distributing at least one signal based on the comparison step." This is, again, apparently directed to the *purpose* of DRM or access control—but its inclusion does not constitute an inventive step sufficient to save the claim.

c. '494 Patent

- **Claim 11** is a system claim similar to claim 11 of the '472 Patent, but using "perceptible characteristics representative of parameters to differentiate between versions of the reference signal" to generate abstracts (instead of "selectable criteria"). This limitation is not materially distinct from the similar limitation discussed above regarding claim 18 of the '700 Patent.
- **Claim 15** is dependent on claim 11, but includes the further limitation that "the stored abstracts comprise a self-similar representation of at least one reference signal." In light of the specification, this limitation simply appears to contemplate generating a hash or compression of the signal to serve as the abstract. *See* '494 Patent at 7:49-54. As noted above, the addition of this well understood, routine activity does not save the claim.
- **Claim 17** depends on claim 11, and includes the limitation that "at least one abstract comprises data describing a portion of the characteristics of its associated reference signal." As with claim 2 of the '472 Patent, generating an abstract based on only a portion of the characteristics of the signal, instead of the signal in its entirety, still falls squarely within the realm of the abstract concept discussed above.
- **Claim 29** covers a system materially similar to that of claim 11, but focuses on

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matching instead of comparisons and requires the use of more than one reference signal. Again, none of these minor variations saves the claim.

d. ’175 Patent

- **Claim 1** covers a system similar to many of the preceding claims, contemplating the use of generic computer components, such as “non transitory memory,” “processor[s],” and “database[s].” As with some of the preceding claims, for instance claim 15 of the ’494 Patent, the abstract must be “similar” to the signal from which it is derived, but reduced in size (e.g., a hash). The key distinction is that this claim contemplates the creation of *two* databases of distinct abstracts for the reference signals, and does *not* include a comparison step. This claim is therefore directed to accomplishing a subset of the abstract idea discussed above, but twice for each signal and in a different manner each time. The former aspect broadens, rather than limits, the claim’s scope. Neither constitutes an inventive concept sufficient to save the claim.
- **Claim 8** is structured similarly to claim 1, but involves only a single database and focuses on facilitating possible comparisons “of different versions of a visual work and a multimedia work” by generating abstracts based on “signal characteristic parameters that differentiate between” different versions of the works. Limiting its scope to broad categories of possible signals—visual and multimedia works—does not save the claim. As noted above as to claim 18 of the ’700 Patent, neither does the use of “signal characteristic parameters.”
- **Claim 11** is similar to claim 8, but does not require the use of signal characteristic parameters and includes a comparison step with a query signal, as do many of the earlier addressed claims.
- **Claim 12** depends on claim 11, with the additional limitation that the compare process indicates the absence of a match between the query signal abstract and the reference signal abstracts stored in a database. This additional routine limitation does not save the claim.

- **Claim 16** is dependent on claim 12, but includes the further limitation that the processor generating and storing the abstracts "is programmed or structured to use an algorithm to generate" the abstracts. This generic reference to the use of an unspecified "algorithm" hardly limits the scope of claim 12, if at all, and certainly does not save the claim from invalidity. *See Digitech Image Technologies, LLC v. Electronics for Imaging, Inc.*, 758 F.3d 1344, 1351 (Fed. Cir. 2014) ("Without additional limitations, a process that employs mathematical algorithms to manipulate existing information to generate additional information is not patent eligible.").
- **Claim 17** is similar to claim 11, but the comparison component is absent and the claim instead includes a requirement that the system be "programmed or structured to apply at least one of psycho-acoustic model and psycho-visual model to generate" the reference abstracts. The specification notes that psycho-acoustic/psycho-visual-focused compression is in the prior art and explains the approach is intended to "mimic[] human perception." *See, e.g.*, '175 Patent at 7:40-49; *see also id*. at 14:41-44 ("Similar to the goals of a psychoacoustic model, a psychovisual model attempts to represent a visual image with less data, and yet preserve those perceptual qualities that permit a human to recognize the original visual image."); *id*. at 7:42-43 ("Most compression is either lossy or lossless and is designed with psychoacoustic or psychovisual parameters. That is to say, the signal is compressed to retain what is 'humanly-perceptible.'"); *id*. at 4:18-21 (referencing prior art data reduction techniques based on "perceptual models" such as AAC, MP3, JPEG, GIF, or MPEG encoding). This approach falls squarely within the prior art and/or the abstract concept discussed above, and introduces no inventive concept.

e. '728 Patent

- **Claim 1** describes a method for using an "electronic system" to create "data

reduced,"[7] "self-similar" abstracts of one reference signal, doing the same for one query signal, and comparing the two to determine whether the abstracts match. This claim's scope is similar to that of the representative claim; the additional limits of creating a hash-based (or similar) abstract, and of using an "electronic system," do not save the claim for the reasons previously explained.

- **Claim 4** depends on claim 1, but also involves the creation of a second abstract, from a second reference signal. This does nothing to save the claim.
- **Claim 5** depends on claim 4, but discusses "changing selected criteria" for generating the reference signal abstracts. The limitation of enabling the abstract generation to be based upon selectable criteria does not save the claim for the reasons discussed above.
- **Claim 16** depends on claim 1, but includes a match counter. For the reasons discussed above, including as to claim 3 of the '472 Patent, this limitation does not save the claim.
- **Claim 25** essentially describes a system for implementing claim 1, with a recitation of generic components (e.g., a "receiver" and a "processor"). This claim therefore falls along with the method claim.
- Finally, **claim 26** depends on claim 25, with the additional limitation that the "system is configured to apply at least one spectral transform" to the reference signal during the abstract-generation process. As with the unspecific reference to use of "algorithms" discussed above, the reference to use of "spectral transforms"—acknowledged by the specification to be a mathematical method to

[7] This language appears redundant in light of the Prior Construction of the term "abstract," which describes the abstract as "data-reduced." Admittedly, "[i]t is settled law that when a patent claim does not contain a certain limitation and another claim does, that limitation cannot be read into the former claim in determining either validity or infringement." *VMWare, Inc. v. Connectix Corp.*, No. C 02-3705 CW, 2005 WL 6220090, at *12 (N.D. Cal. Mar. 25, 2005) (quoting *SRI Int'l v. Matsushita Elec. Corp. of Am.*, 775 F.2d 1107, 1122 (Fed. Cir. 1985)). Nevertheless, the Court adopts the Prior Construction for purposes of this motion despite this apparent redundancy in light of the plaintiff's reliance thereon and defendant's stipulation thereto.

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process signals, maintaining "some cognitive or perceptual relationship with the original analog waveform"—falls within the realm of the abstract. *See* '728 Patent at 11:25-31. The specification suggests "spectral transforms" refer to prior art; certainly, the patent does nothing to teach a person having ordinary skill in the art how to perform a spectral transform, taking for granted that such a process would be well understood at the time the patent was filed. *See id*. at 4:20-26. Moreover, the Federal Circuit has held that system claims directed to describing mathematical transformations undertaken in connection with digital image processing were not directed to patent-eligible subject matter where they did not "require any physical embodiment." *See Digitech Image Technologies, LLC v. Electronics for Imaging, Inc.*, 758 F.3d 1344, 1350 (Fed. Cir. 2014). This claim, similarly, appears directed to application of a mathematical model to data in a digital environment with no resulting physical embodiment.

Thus, all claims at issue are not patent-eligible.

IV. CONCLUSION

For the foregoing reasons, the Court **GRANTS** the defendant's motion for judgment on the pleadings, finding the asserted claims listed in the motion to be invalid. In light of the rulings herein, the plaintiff's request for leave to amend is denied as futile. *See Foman v. Davis,* 371 U.S. 178, 182 (1962).

This Order terminates Docket Number 59.

IT IS SO ORDERED.

Dated: September 8, 2015

Yvonne Gonzalez Rogers

YVONNE GONZALEZ ROGERS
UNITED STATES DISTRICT COURT JUDGE

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

United States District Court
Northern District of California

BLUE SPIKE, LLC, Plaintiff, v. **GOOGLE INC.**, Defendant.	Case No. 14-cv-01650-YGR **ORDER TO SHOW CAUSE** Re: Dkt. No. 75

In light of the Court's Order granting judgment on the pleadings as to all asserted claims other than disputed claim 30 of U.S. Patent No. 8,712,728 (Dkt. No. 75 at 1 n.1), the parties are hereby **ORDERED TO SHOW CAUSE** why that claim should not be held invalid on the same grounds as the other asserted claims. If any party objects to that outcome, the party shall file a brief of no more than five (5) pages by **September 14, 2015**, presenting argument for why that claim should not be treated similarly. A non-objecting party may file a five (5) page response to an objection by **September 16, 2015**.

IT IS SO ORDERED.

Dated: September 8, 2015

YVONNE GONZALEZ ROGERS
UNITED STATES DISTRICT COURT JUDGE

United States District Court
Northern District of California

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

BLUE SPIKE, LLC, Plaintiff, v. **GOOGLE INC.,** Defendant.	Case No. 14-cv-01650-YGR **ORDER RE: REMAINING PATENT CLAIM** Re: Dkt. No. 77

On September 8, 2015, the Court issued an order granting defendant's motion for judgment on the pleadings, finding all patent claims at issue in the motion to be invalid (Dkt. No. 75), and issued an order to show cause as to why the sole remaining patent claim at issue in this case, but not raised in the motion, should not be held invalid on the same grounds (Dkt. No. 76). The parties "do not dispute that Claim 30 of U.S. Patent No. 8,712,728 would be held invalid under the Court's reasoning as to the other asserted claims in its Order Granting Motion for Judgment on the Pleadings." (Dkt. No. 77 at 1-2.) Thus, in the absence of any objection, the Court finds that claim invalid for the same reasons discussed in the September 8, 2015 Order at Docket Number 75. As all asserted claims have been held invalid, the Court directs defendant to file a proposed form of judgment, approved as to form by plaintiff, by no later than **September 23, 2015**.

IT IS SO ORDERED.

Dated: September 18, 2015

YVONNE GONZALEZ ROGERS
UNITED STATES DISTRICT COURT JUDGE

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
OAKLAND DIVISION

BLUE SPIKE, LLC,

Plaintiff,

v.

GOOGLE INC.,

Defendant.

Case No. 14-cv-01650 (YGR)

~~[PROPOSED FORM OF]~~ JUDGMENT INVALIDATING ASSERTED PATENTS PURSUANT TO DKT. NOS. 75, 80

Hearing Date: N/A
Hearing Time: N/A
Courtroom: Courtroom 1, 4th Floor
Judge: Hon. Yvonne Gonzalez Rogers

This action having come before the Court, and pursuant to the Court's Orders: (1) granting Defendant Google Inc.'s ("Google") Motion for Judgment on the Pleadings (Dkt. Nos. 59, 75); and (2) accepting Plaintiff Blue Spike, LLC's ("Blue Spike") Statement of Non-objection (Dkt. No. 77) in response to the Court's Order to Show Cause (Dkt. Nos. 76, 80) – together which find all asserted claims of U.S. Patent Nos. 7,346,472 (the "'472 Patent"), 7,660,700 (the "'700 Patent"), 7,949,494 (the "'494 Patent"), 8,214,175 (the "'175 Patent"), and 8,712,728 (the "'728 Patent") (collectively, the "Patents-In-Suit") invalid pursuant to 35 U.S.C. § 101 – IT IS HEREBY ADJUDGED AND ORDERED that:

1. For the reasons set forth in the Court's Order on September 8, 2015 (Dkt. No. 75), the following asserted claims are invalid pursuant to 35 U.S.C. § 101:

- claims 1-4, 8, and 11 of the '472 Patent;
- claims 1, 10-12, 18, 21, 27, 40, and 51 of the '700 Patent;
- claims 11, 15, 17, and 29 of the '494 Patent;
- claims 1, 8, 11, 12, 16, and 17 of the '175 Patent; and
- claims 1, 4, 5, 16, 25, and 26 of the '728 Patent.

2. For the same reasons set for in the Court's Order from September 8, 2015 (Dkt. No. 75) and pursuant to the Court's Order from September 18, 2015 (Dkt. No. 80), the following asserted claim is also invalid pursuant to 35 U.S.C. § 101:

- claim 30 of the '728 Patent.

3. The foregoing claims of the Patents-In-Suit represent all pending claims at issue in this case.

4. WHEREFORE JUDGMENT on the pleadings is entered in this case in favor of Defendant Google and against Plaintiff Blue Spike.

Dated: October 1, 2015

By: ______________________
Judge Yvonne Gonzalez Rogers
United States District Judge

US007346472B1

(12) **United States Patent**
Moskowitz et al.

(10) **Patent No.: US 7,346,472 B1**
(45) **Date of Patent: Mar. 18, 2008**

(54) **METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS**

(75) Inventors: **Scott A. Moskowitz**, Miami, FL (US); **Michael W. Berry**, Albuquerque, NM (US)

(73) Assignee: **Blue Spike, Inc.**, Sunny Isles Beach, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 722 days.

(21) Appl. No.: **09/657,181**

(22) Filed: **Sep. 7, 2000**

(51) **Int. Cl.**
G06F 19/00 (2006.01)

(52) **U.S. Cl.** **702/182**; 707/1; 707/2; 707/3; 707/10; 709/209; 705/51; 380/28

(58) **Field of Classification Search** 702/182; 707/3, 1, 2, 10; 382/100, 232, 282; 380/200, 380/201, 202, 203, 217, 28; 713/176; 709/209; 705/51
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,947,825	A *	3/1976	Cassada	707/3
3,984,624	A	10/1976	Waggener	
3,986,624	A	10/1976	Cates, Jr. et al.	
4,038,596	A	7/1977	Lee	
4,200,770	A	4/1980	Hellman et al.	
4,218,582	A	8/1980	Hellman et al.	
4,339,134	A	7/1982	Macheel	
4,405,829	A	9/1983	Rivest et al.	
4,424,414	A	1/1984	Hellman et al.	
4,528,588	A	7/1985	Lofberg	
4,672,605	A	6/1987	Hustig et al.	
4,748,668	A	5/1988	Shamir et al.	
4,789,928	A	12/1988	Fujisaki	
4,827,508	A	5/1989	Shear	
4,876,617	A	10/1989	Best et al.	
4,896,275	A	1/1990	Jackson	
4,908,873	A	3/1990	Philibert et al.	
4,939,515	A	7/1990	Adelson	
4,969,204	A	11/1990	Jones et al.	
4,972,471	A	11/1990	Gross et al.	
4,977,594	A	12/1990	Shear	
4,979,210	A	12/1990	Nagata et al.	
4,980,782	A	12/1990	Ginkel	
5,050,213	A	9/1991	Shear	
5,073,925	A	12/1991	Nagata et al.	
5,077,665	A	12/1991	Silverman et al.	
5,113,437	A	5/1992	Best et al.	
5,136,581	A	8/1992	Muehrcke	
5,161,210	A	11/1992	Druyvesteyn et al.	
5,243,423	A	9/1993	DeJean et al.	
5,243,515	A	9/1993	Lee	
5,287,407	A	2/1994	Holmes	
5,319,735	A	6/1994	Preuss et al.	
5,341,429	A	8/1994	Stringer et al.	
5,341,477	A	8/1994	Pitkin et al.	
5,363,448	A	11/1994	Koopman et al.	
5,365,586	A	11/1994	Indeck et al.	
5,369,707	A	11/1994	Follendore, III	
5,379,345	A	1/1995	Greenberg	
5,394,324	A	2/1995	Clearwater	
5,398,285	A	3/1995	Borgelt et al.	
5,406,627	A	4/1995	Thompson et al.	
5,408,505	A	4/1995	Indeck et al.	
5,410,598	A	4/1995	Shear	
5,412,718	A	5/1995	Narasimhalv et al.	
5,418,713	A	5/1995	Allen	
5,428,606	A	6/1995	Moskowitz	
5,450,490	A	9/1995	Jensen et al.	
5,469,536	A	11/1995	Blank	
5,478,990	A	12/1995	Montanari et al.	
5,479,210	A *	12/1995	Cawley et al.	348/390.1
5,487,168	A	1/1996	Geiner et al.	
5,493,677	A	2/1996	Balogh et al.	
5,497,419	A	3/1996	Hill	
5,506,795	A	4/1996	Yamakawa	

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0372601	A1	6/1990
EP	0565947	A1	10/1993
EP	0581317	A2	2/1994
EP	0649261		4/1995
EP	0651554	A	5/1995

(Continued)

OTHER PUBLICATIONS

Sirbu, M. et al: "Netbill: An Internet Commerce System Optimized for Network Delivered Services," Digest of Papers of the Computer Society Computer Conference (Spring), Mar. 5, 1995, pp. 20-25, vol. CONF. 40, COMPCON, US, Los Alamitos, IEEE Comp. Soc. Press.

Schunter M. et al., "A status report on the SEMPER framework for secure electronic commerce," Computer Networks and ISDN Systems, Sep. 30, 1998, pp. 1501-1510, vol. 30, No. 16-18, NL, North Holland Publishing, Amsterdam.

(Continued)

Primary Examiner—Carol S. W. Tsai

(57) **ABSTRACT**

A method and system for monitoring and analyzing at least one signal are disclosed. An abstract of at least one reference signal is generated and stored in a reference database. An abstract of a query signal to be analyzed is then generated so that the abstract of the query signal can be compared to the abstracts stored in the reference database for a match. The method and system may optionally be used to record information about the query signals, the number of matches recorded, and other useful information about the query signals. Moreover, the method by which abstracts are generated can be programmable based upon selectable criteria. The system can also be programmed with error control software so as to avoid the re-occurrence of a query signal that matches more than one signal stored in the reference database.

14 Claims, No Drawings

U.S. PATENT DOCUMENTS

5,513,261	A		4/1996	Maher	
5,530,739	A		6/1996	Okada	
5,530,751	A		6/1996	Morris	
5,530,759	A		6/1996	Braudaway et al.	
5,539,735	A		7/1996	Moskowitz	
5,548,579	A		8/1996	Lebrun et al.	
5,568,570	A		10/1996	Rabbani	
5,579,124	A		11/1996	Aijala et al.	
5,581,703	A		12/1996	Baugher et al.	
5,583,488	A		12/1996	Sala et al.	
5,598,470	A		1/1997	Cooper et al.	
5,606,609	A		2/1997	Houser et al.	
5,613,004	A		3/1997	Cooperman et al.	
5,617,119	A		4/1997	Briggs et al.	
5,625,690	A		4/1997	Michel et al.	
5,629,980	A		5/1997	Stefik et al.	
5,633,932	A		5/1997	Davis et al.	
5,634,040	A		5/1997	Her et al.	
5,636,276	A		6/1997	Brugger	
5,636,292	A		6/1997	Rhoads	
5,640,569	A		6/1997	Miller et al.	
5,646,997	A		7/1997	Barton	
5,659,726	A		8/1997	Sandford, II et al.	
5,664,018	A		9/1997	Leighton	
5,673,316	A		9/1997	Auerbach et al.	
5,680,462	A		10/1997	Miller et al.	
5,687,236	A		11/1997	Moskowitz et al.	
5,689,587	A		11/1997	Bender et al.	
5,696,828	A		12/1997	Koopman, Jr.	
5,719,937	A		2/1998	Warren et al.	
5,721,788	A		2/1998	Powell et al.	
5,734,752	A		3/1998	Knox	
5,737,416	A		4/1998	Cooper et al.	
5,737,733	A		4/1998	Eller	
5,740,244	A		4/1998	Indeck et al.	
5,745,569	A		4/1998	Moskowitz et al.	
5,748,783	A		5/1998	Rhoads	
5,751,811	A		5/1998	Magnotti et al.	
5,754,697	A	*	5/1998	Fu et al.	382/232
5,757,923	A		5/1998	Koopman, Jr.	
5,765,152	A		6/1998	Erickson	
5,774,452	A		6/1998	Wolosewicz	
5,790,677	A		8/1998	Fox et al.	
5,799,083	A		8/1998	Brothers et al.	
5,809,139	A		9/1998	Girod et al.	
5,809,160	A		9/1998	Powell et al.	
5,822,432	A		10/1998	Moskowitz et al.	
5,828,325	A		10/1998	Wolosewicz et al.	
5,832,119	A		11/1998	Rhoads	
5,848,155	A		12/1998	Cox	
5,859,920	A		1/1999	Daly et al.	
5,870,474	A		2/1999	Wasilewski et al.	
5,884,033	A		3/1999	Duvall et al.	
5,889,868	A		3/1999	Moskowitz et al.	
5,893,067	A		4/1999	Bender et al.	
5,894,521	A		4/1999	Conley	
5,903,721	A		5/1999	Sixtus	
5,905,800	A		5/1999	Moskowitz et al.	
5,905,975	A		5/1999	Ausubel	
5,912,972	A		6/1999	Barton	
5,915,027	A		6/1999	Cox et al.	
5,917,915	A		6/1999	Hirose	
5,920,900	A		7/1999	Poole et al.	
5,930,369	A		7/1999	Cox et al.	
5,930,377	A		7/1999	Powell et al.	
5,940,134	A		8/1999	Wirtz	
5,943,422	A		8/1999	Van Wie et al.	
5,963,909	A		10/1999	Warren et al.	
5,973,731	A		10/1999	Schwab	
5,974,141	A		10/1999	Saito	
5,991,426	A		11/1999	Cox et al.	
5,999,217	A		12/1999	Berners-Lee	
6,009,176	A		12/1999	Gennaro et al.	
6,029,126	A	*	2/2000	Malvar	704/204
6,041,316	A		3/2000	Allen	
6,049,838	A		4/2000	Miller et al.	
6,051,029	A		4/2000	Paterson et al.	
6,061,793	A		5/2000	Tewfik et al.	
6,069,914	A		5/2000	Cox	
6,078,664	A		6/2000	Moskowitz et al.	
6,081,251	A		6/2000	Sakai et al.	
6,081,597	A		6/2000	Hoffstein et al.	
6,088,455	A	*	7/2000	Logan et al.	380/200
6,131,162	A		10/2000	Yoshiura et al.	
6,141,753	A		10/2000	Zhao et al.	
6,141,754	A		10/2000	Choy	
6,154,571	A		11/2000	Cox et al.	
6,199,058	B1		3/2001	Wong et al.	
6,205,249	B1	*	3/2001	Moskowitz	382/232
6,208,745	B1		3/2001	Florenio et al.	
6,230,268	B1		5/2001	Miwa et al.	
6,233,347	B1		5/2001	Chen et al.	
6,233,684	B1		5/2001	Stefik et al.	
6,240,121	B1		5/2001	Senoh	
6,272,634	B1		8/2001	Tewfik et al.	
6,275,988	B1		8/2001	Nagashima et al.	
6,278,780	B1		8/2001	Shimada	
6,278,791	B1		8/2001	Honsinger et al.	
6,282,300	B1	*	8/2001	Bloom et al.	382/100
6,282,650	B1		8/2001	Davis	
6,285,775	B1		9/2001	Wu et al.	
6,301,663	B1		10/2001	Kato et al.	
6,310,962	B1		10/2001	Chung et al.	
6,330,335	B1		12/2001	Rhoads	
6,330,672	B1		12/2001	Shur	
6,351,765	B1		2/2002	Pietropaolo et al.	
6,373,892	B1		4/2002	Ichien et al.	
6,377,625	B1	*	4/2002	Kim	375/240.08
6,381,618	B1		4/2002	Jones et al.	
6,381,747	B1		4/2002	Wonfor et al.	
6,385,329	B1		5/2002	Sharma et al.	
6,405,203	B1		6/2002	Collart	
6,415,041	B1		7/2002	Oami et al.	
6,425,081	B1		7/2002	Iwamura	
6,430,302	B2	*	8/2002	Rhoads	382/100
6,442,283	B1	*	8/2002	Tewfik et al.	382/100
6,453,252	B1		9/2002	Laroche	
6,457,058	B1		9/2002	Ullum et al.	
6,493,457	B1		12/2002	Quackenbush	
6,522,767	B1		2/2003	Moskowitz et al.	
6,522,769	B1		2/2003	Rhoads et al.	
6,523,113	B1		2/2003	Wehrenberg	
6,530,021	B1		3/2003	Epstein et al.	
6,539,475	B1		3/2003	Cox et al.	
6,557,103	B1		4/2003	Boncelet, Jr. et al.	
6,584,125	B1	*	6/2003	Katto	370/537
6,598,162	B1		7/2003	Moskowitz	
6,606,393	B1	*	8/2003	Xie et al.	382/100
6,647,424	B1		11/2003	Pearson et al.	
6,665,489	B2		12/2003	Collart	
6,668,246	B1		12/2003	Yeung et al.	
6,687,683	B1		2/2004	Harada et al.	
6,725,372	B1	*	4/2004	Lewis et al.	713/176
6,754,822	B1		6/2004	Zhao	
6,775,772	B1		8/2004	Binding et al.	
6,785,815	B1		8/2004	Serret-Avila et al.	
6,823,455	B1		11/2004	Macy et al.	
6,977,894	B1		12/2005	Achilles et al.	
6,978,370	B1		12/2005	Kocher	
7,043,050	B2		5/2006	Yuval	
7,058,570	B1		6/2006	Yu et al.	
2002/0026343	A1		2/2002	Duenke	
2002/0097873	A1		7/2002	Petrovic	
2002/0103883	A1		8/2002	Haverstock et al.	

2003/0126445 A1	7/2003	Wehrenberg
2003/0133702 A1	7/2003	Collart
2004/0037449 A1	2/2004	Davis et al.
2004/0128514 A1	7/2004	Rhoads
2005/0160271 A9	7/2005	Brundage et al.
2006/0005029 A1	1/2006	Petrovic et al.
2006/0013395 A1	1/2006	Brundage et al.

FOREIGN PATENT DOCUMENTS

NL	100523	9/1998
WO	WO 95/14289	5/1995
WO	96/29795	9/1996
WO	97/24833	7/1997
WO	WO 9744736	11/1997
WO	WO98/37513	8/1998
WO	WO 9952271	10/1999
WO	WO 99/62044	12/1999
WO	WO 9963443	12/1999

OTHER PUBLICATIONS

Konrad, K. et al., "Trust and electronic commerce-more than a technical problem," Proceedings of the 18th IEEE Symposium on Reliable Distributed Systems, Proceedings 18th IEEE Symposium on Reliable Distributed Systems, Oct. 19-22, 1999, pp. 360-365, Lausanne, Switzerland.
Kini, A. et al., "Trust in electronic commerce: definition and theoretical considerations," Proceedings of Thirty-first Hawaii International Conference on System Sciences (Cat. No. 98TB100216), Jan. 6-9, 1998, pp. 51-61, Los Alamitos, CA, USA, IEEE Comput. Soc.
Steinauer D.D. et al., "Trust and traceability in electronic commerce," Standard View, Sep. 1997, pp. 118-124, vol. 5, No. 3, ACM, USA.
Moskowitz, Scott, "Bandwidth as Currency," IEEE MultiMedia, Jan.-Mar. 2003, pp. 14-21.
Pending U.S. Appl. No. 08/999,766, filed Jul. 23, 1997, titled "Steganographic Method and Device," assignee Wistaria Trading, Inc.
Pending U.S. Appl. No. 09/456,319, filed Dec. 8, 1999, titled "Transform Implementation of Digital Watermarks," assignee Wistaria Trading, Inc.
Pending U.S. Appl. No. 08/674,726, filed Jul. 2, 1996, titled "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management," assignee Wistaria Trading, Inc.
Pending U.S. Appl. No. 09/545,589, filed Apr. 7, 2000, titled "Method and System for Digital Watermarking," assignee Wistaria Trading, Inc.
Pending U.S. Appl. No. 09/046,627, filed Mar. 24, 1998, titled "Method for Combining Transfer Function with Predetermined Key Creation," inventor: Moskowitz et al.
Pending U.S. Appl. No. 09/594,719, filed Jun. 16, 2000, titled "Utilizing Data Reduction in Steganographic and Cryptographic Systems," inventor: Moskowitz et al.
Pending U.S. Appl. No. 09/731,040, filed Dec. 7, 2000, titled "Systems, Methods and Devices for Trusted Transactions," assignee Blue Spike.
Pending U.S. Appl. No. 10/049,101, filed Feb. 8, 2002, titled "A Secure Personal Content Server," assignee Blue Spike.
Pending U.S. Appl. No. 09/657,181, filed Sep. 7, 2000, titled "Method and Device for Monitoring and Analyzing Signals," assignee Blue Spike.
Pending U.S. Appl. No. 09/671,739, filed Sep. 29, 2000, titled "Method and Device for Monitoring and Analyzing Signals," assignee Blue Spike.
Pending U.S. Appl. No. 09/956,262, filed Sep. 20, 2001, titled "Improved Security Based on Subliminal and Supraliminal Channels for Data Objects," assignee Blue Spike.
Pending U.S. Appl. No. 09/731,039, filed Dec. 7, 2000, titled "System and Method for Permitting Open Access to Data Objects and For Securing Data within the Data Objects," assignee Blue Spike.
Pending U.S. Appl. No. 10/369,344, filed Feb. 18, 2003, titled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data," assignee Wistaria Trading.
Pending U.S. Appl. No. 09/789,711, filed Feb. 22, 2001, titled "Optimization Methods for the Insertion, Protection and Detection of Digital Watermarks," assignee Wistaria Trading.
Pending U.S. Appl. No. 09/644,098, filed Aug. 23, 2000, titled "Multiple Transform Utilization and Application for Secure Digital Watermarking," inventor S. Moskowitz.
Pending U.S. Appl. No. 09/767,733, filed Jan. 24, 2001, titled "Multiple Transform Utilization and Application for Secure Digital Watermarking," inventor S. Moskowitz.
Pending U.S. Appl. No. 10/417,231, filed Apr. 17, 2003, titled "Method, System and Devices for Packet Watermarking and Efficient Provisioning of Bandwidth," inventor S. Moskowitz.
Pending U.S. Appl. No. 09/281,279, filed Mar. 30, 1999, titled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data," inventor S. Moskowitz.
Schneier, Bruce, Applied Cryptography, 2nd Ed., John Wiley & Sons, pp. 9-10, 1996.
Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 46, 1997.
Merriam-Webster's Collegiate Dictionary, 10th Ed., Merriam Webster, Inc., p. 207.
Brealy, et al., Principles of Corporate Finance, "Appendix A-Using Option Valuation Models", 1984, pp. 448-449.
Copeland, et al., Real Options:A Practioner's Guide, 2001 pp. 106-107, 201-202, 204-208.
Sarkar, M. "An Assessment of Pricing Mechanisms for the Internet-A Regulatory Imperative", presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/jep/works/SarkAsses.html on March.
Crawford, D.W. "Pricing Network Usage:A Market for Bandwith of Market Communication?" presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/jep/works/CrawMarket.html on March.
Low, S.H., "Equilibrium Allocation and Pricing of Variable Resources Among User-Suppliers", 1988. http://www.citesear.nj.nec.com/366503.html.
Caronni, Germano, "Assuring Ownership Rights for Digital Images", published proceeds of reliable IT systems, v15 '95, H.H. Bruggemann and W Gerhardt-Hackel (Ed.), Viewing Publishing Company, Germany, 1995.
Zhao, Jian. "A WWW Service to Embed and Prove Digital Copyright Watermarks", Proc. of the european conf. on Multimedia Applications, Services & Techinques, Louvain-La-Neuve, Belgium, May 1996.
Gruhl,Daniel et al.,Echo Hiding. In Proceeding of the Workshop on Information Hiding. No. 1174 in Lecture Notes in Computer Science.Cambridge.England (May/Jun. 1996).
Oomen,A.W.J. et al., A Variable Bit Rate Buried Data Channel for Compact Disc, J.Audio Eng.Sc.,vol. 43,No. 1/2,pp. 23-28 (1995).
Ten Kate,W. et al., A New Surround-Stereo-Surround Coding Techniques, J. Audio Eng.Soc.,vol. 40,No. 5,pp. 376-383 (1992).
Gerzon, Michael et al., A High Rate Buried Data Channel for Audio CD, presentation notes, Audio Engineering Soc. 94th Convention (1993).
Sklar,Bernard, Digital Communications, pp. 601-603 (1988).
Jayant, N.S. et al., Digital Coding of Waveforms, Prentice Hall Inc., Englewood Cliffs,NJ, pp. 486-509 (1984).
Bender, Walter R. et al., Techniques for Data Hiding, SPIE Int. Soc. Opt. Eng., vol. 2420, pp. 164-173, 1995.
Zhao, Jian et al., Embedding Robust Labels into Images for Copyright Protection, (xp 000571976), pp. 242-251, 1995.
Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 175, 1997.
Schneier, Bruce, Applied Cryptography, 1st Ed., pp. 67-68, 1994.
Ten Kate, W. et al., "Digital Audio Carrying Extra Information", IEEE, CH 2847-2/90/0000-1097, (1990).
van Schyndel, et al. A digital Watermark, IEEE Int'l Computer Processing Conference, Austin,TX, Nov. 13-16, 1994, pp. 86-90.

Smith, et al. Modulation and Information Hiding in Images, Springer Verlag, 1st Int'l Workshop, Cambridge, UK, May 30-Jun. 1, 1996, pp. 207-227.
Kutter, Martin et al., Digital Signature of Color Images Using Amplitude Modulation, SPIE-E197, vol. 3022, pp. 518-527.
Puate, Joan et al., Using Fractal Compression Scheme to Embed a Digital Signature into an Image, SPIE-96 Proceedings, vol. 2915, Mar. 1997, pp. 108-118.
Swanson, Mitchell D.,et al., Transparent Robust Image Watermarking, Proc. of the 1996 IEEE Int'l Conf. on Image Processing, vol. 111, 1996 , pp. 211-214.
Swanson, Mitchell D., et al. Robust Data Hiding for Images, 7th IEEE Digital Signal Processing Workshop, Leon, Norway. Sep. 1-4, 1996, pp. 37-40.
Zhao, Jian et al., Embedding Robust Labels into Images for Copyright Protection, Proceeding of the Know Right '95 Conference, pp. 242-251.
Koch, E., et al., Towards Robust and Hidden Image Copyright Labeling, 1995 IEEE Workshop on Nonlinear Signal and Image Processing, Jun. 1995 Neos Marmaras pp. 4.
Van Schyandel, et al., Towards a Robust Digital Watermark, Second Asain Image Processing Conference, Dec. 6-8, 1995,Singapore, vol. 2,pp. 504-508.
Tirkel,A.Z., A Two-Dimensional Digital Watermark, DICTA '95, Univ. of Queensland, Brisbane, Dec. 5-8, 1995, pp. 7.
Tirkel,A.Z., Image Watermarking-A Spread Spectrum Application, ISSSTA '96, Sep. 1996, Mainz, German, pp. 6.
O'Ruanaidh, et al. Watermarking Digital Images for Copyright Protection, IEEE Proceedings, vol. 143, No. 4, Aug. 96, pp. 250-256.
Cox, et al., Secure Spread Spectrum Watermarking for Multimedia, NEC Research Institude, Techinal Report 95-10, pp. 33.
Kahn, D., The Code Breakers, The MacMillan Company, 1969, pp. xIII, 81-83,513,515,522-526,863.
Boney, et al., Digital Watermarks for Audio Signals, EVSIPCO, 96, pp. 473-480.
Dept. of Electrical Engineering, Del Ft University of Technology, Del ft The Netherlands,Cr.C. Langelaar et al.,Copy Protection for Mulitmedia Data based on Labeling Techniques , Jul. 1996 9 pp.
F. Hartung, et al., Digital Watermarking of Raw and Compressed Video, SPIE vol. 2952, pp. 205-213.
Craver, et al., Can Invisible Watermarks Resolve Rightful Ownerships? IBM Research Report, RC 20509 (Jul. 25, 1996) 21 pp.
Press, et al., Numerical Recipes In C, Cambridge Univ. Press, 1988, pp. 398-417.
Pohlmann, Ken C., Principles of Digital Audio, 3rd Ed., 1995, pp. 32-37, 40-48, 138, 147-149,332,333,364, 499-501,508-509,564-571.
Pohlmann, Ken C., Principles of Digital Audio, 2nd Ed., 1991, pp. 1-9,19-25,30-33,41-48,54-57,86-107,375-387.
Schneier, Bruce, Applied Cryptography, John Wiley & Sons, inc., New York, 1994, pp. 68,69,387-392,1-57,273-275,321-324.
Boney, et al., Digital Watermarks for Audio Signals, Proceedings of the International Conf. on Multimedia Computing and Systems, Jun. 17-23, 1996,Hiroshima Japan 0-8186-7436-9196, pp. 473-480.
Johnson, et al., Transform Permuted Watermarking for Copyright Protection of Digital Video, IEEE Globecom 1998, Nov. 8-12, 1998, New York New York vol. 2 1998 pp. 684-689 (ISBN 0-7803-4985-7).
Rivest, et al., "Pay Word and Micromint: Two Simple Micropayment Schemes," MIT Laboratory for Computer Science, Cambridge, MA, May 7, 1996 pp. 1-18.
Bender, et al., Techniques for Data Hiding, IBM Systems Journal, vol. 35, Nos. 3 & 4,1996,pp. 313-336.
Moskowitz, Bandwith as Currency, IEEE Multimedia, Jan.-Mar. 2003, pp. 14-21.
Moskowitz, Multimedia Security Technologies for Digital Rights Management, 2006, Academic Press, "Introduction-Digital Rights Management" pp. 3-22.
Rivest, et al., "*Pay Word and MicroMint: Two Simple Micropayment Schemes*" Mir Laboratory for Computer Science, Cambridge, MA, Apr. 27, 2001, pp. 1-18.
Tomsich, et al., "Towards a secure and de-centralized digital watermarking infrastructure for the protection of Intellectual Property", in Electronic Commerce and Web Technologies, Proceedings (ECWEB.
Moskowitz, "What is Acceptable Quality in the Application of Digital Watermarking: Trade-offs of Security, Robustness and Quality", IEEE Computer Society Proceedings of ITCC 2002 Apr. 10, 2002 pp. 80-84.
Lemma, et al. "Secure Watermark Embedding through Partial Encryption", International Workshop on Digital Watermarking ("IWDW" 2006), Springer Lecture Notes in Computer Science 2006, (to appear) 13.
Kocher, et al., "Self Protecting Digital Content", Technical Report from the CRI Content Security Research Initiative, Crytography Research, Inc. 2002-2003 14 pages.
Sirbu, M. et al., "Net Bill: An Internet Commerce System Optimized for Network Delivered Services", Digest of Papers of the Computer Society Computer Conference (Spring) Mar. 5, 1995 pp. 20-25 vol. CONF40.
Schunter, M. et al., "A Status Report on the SEMPER framework for Secure Electronic Commerce", Computer Networks and ISDN Systems, Sep. 30, 1998 pp. 1501-1510 vol. 30, No. 16-18 NL North Holland.
Konrad, K. et al., "Trust and Elecronic Commerce-more than a techinal problem," Proceedings of the 18th IEEE Symposium on Reliable Distributed Systems Oct. 19-22, 1999 pp. 360-365 Lausanne.
Kini, a. et al., "Trust in Electronic Commerce: Definition and Theoretical Considerations", Proceedings of the 31st Hawaii Int'l Conf. on System Sciences (Cat. No. 98TB100216), Jan. 6-9, 1998, pp. 51-61, Los.
Steinauer D. D., et al., "Trust and Traceability in Electronic Commerce", Standard View, Sep. 1997, pp. 118-124, vol. 5 No. 3, ACM, USA.
Hartung, et al. "Multimedia Watermarking Techniques", Proceedings of the IEEE, Special Issue, Identification & Protection of Multimedia Information, pp. 1079-1107 Jul. 1999 vol. 87 No. 7 IEEE.

* cited by examiner

METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of pending U.S. patent application Ser. No. 08/999,766, filed Jul. 23, 1997, entitled "Steganographic Method and Device"; pending U.S. patent application Ser. No. 08/772,222, filed Dec. 20, 1996, entitled "Z-Transform Implementation of Digital Watermarks"; pending U.S. patent application Ser. No. 09/456,319, filed Dec. 8, 1999, entitled "Transform Implementation of Digital Watermarks"; pending U.S. patent application Ser. No. 08/674,726, filed Jul. 2, 1996, entitled "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management"; pending U.S. patent application Ser. No. 09/545,589, filed Apr. 7, 2000, entitled "Method and System for Digital Watermarking"; pending U.S. patent application Ser. No. 09/046,627, filed Mar. 24, 1998, entitled "Method for Combining Transfer Function with Predetermined Key Creation"; pending U.S. patent application Ser. No. 09/053,628, filed Apr. 2, 1998, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking"; pending U.S. patent application Ser. No. 09/281,279, filed Mar. 30, 1999, entitled "Optimization Methods for the Insertion, Protection, and Detection . . . "; U.S. patent application Ser. No. 09/594,719, filed Jun. 16, 2000, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems" (which is a continuation-in-part of PCT application No. PCT/US00/06522, filed Mar. 14, 2000, which PCT application claimed priority to U.S. Provisional Application No. 60/125,990, filed Mar. 24, 1999); now abandoned U.S. Application No. 60/169,274, filed Dec. 7, 1999, entitled "Systems, Methods And Devices For Trusted Transactions"; and PCT Application No. PCT/US00/21189, filed Aug. 4, 2000 (which claims priority to U.S. Patent Application Ser. No. 60/147,134, filed Aug. 4, 1999, and to U.S. Patent Application No. 60/213,489, filed Jun. 23, 2000, both of which are entitled, "A Secure Personal Content Server"). The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties.

In addition, this application hereby incorporates by reference, as if fully stated herein, the total disclosures of U.S. Pat. No. 5,613,004 "Steganographic Method and Device"; U.S. Pat. No. 5,745,569 "Method for Stega-Cipher Protection of Computer Code"; and U.S. Pat. No. 5,889,868 "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data."

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to the monitoring and analysis of digital information. A method and device are described which relate to signal recognition to enhance identification and monitoring activities.

2. Description of the Related Art

Many methods and protocols are known for transmitting data in digital form for multimedia applications (including computer applications delivered over public networks such as the internet or World Wide Web ("WWW"). These methods may include protocols for the compression of data, such that it may more readily and quickly be delivered over limited bandwidth data lines. Among standard protocols for

data compression of digital files may be mentioned the MPEG compression standards for audio and video digital compression, promulgated by the Moving Picture Experts Group. Numerous standard reference works and patents discuss such compression and transmission standards for digitized information.

Digital watermarks help to authenticate the content of digitized multimedia information, and can also discourage piracy. Because piracy is clearly a disincentive to the digital distribution of copyrighted content, establishment of responsibility for copies and derivative copies of such works is invaluable. In considering the various forms of multimedia content, whether "master," stereo, NTSC video, audio tape or compact disc, tolerance of quality will vary with individuals and affect the underlying commercial and aesthetic value of the content. It is desirable to tie copyrights, ownership rights, purchaser information or some combination of these and related data into the content in such a manner that the content must undergo damage, and therefore reduction of its value, with subsequent, unauthorized distribution, commercial or otherwise. Digital watermarks address many of these concerns. A general discussion of digital watermarking as it has been applied in the art may be found in U.S. Pat. No. 5,687,236 (whose specification is incorporated in whole herein by reference).

Further applications of basic digital watermarking functionality have also been developed. Examples of such applications are shown in U.S. Pat. No. 5,889,868 (whose specification is incorporated in whole herein by reference). Such applications have been drawn, for instance, to implementations of digital watermarks that were deemed most suited to particular transmissions, or particular distribution and storage mediums, given the nature of digitally sampled audio, video, and other multimedia works. There have also been developed techniques for adapting watermark application parameters to the individual characteristics of a given digital sample stream, and for implementation of digital watermarks that are feature-based—i.e., a system in which watermark information is not carried in individual samples, but is carried in the relationships between multiple samples, such as in a waveform shape. For instance, natural extensions may be added to digital watermarks that may also separate frequencies (color or audio), channels in 3D while utilizing discreteness in feature-based encoding only known to those with pseudo-random keys (i.e., cryptographic keys) or possibly tools to access such information, which may one day exist on a quantum level.

A matter of general weakness in digital watermark technology relates directly to the manner of implementation of the watermark. Many approaches to digital watermarking leave detection and decode control with the implementing party of the digital watermark, not the creator of the work to be protected. This weakness removes proper economic incentives for improvement of the technology. One specific form of exploitation mostly regards efforts to obscure subsequent watermark detection. Others regard successful over encoding using the same watermarking process at a subsequent time. Yet another way to perform secure digital watermark implementation is through "key-based" approaches.

SUMMARY OF THE INVENTION

A method for monitoring and analyzing at least one signal is disclosed, which method comprises the steps of: receiving at least one reference signal to be monitored; creating an abstract of the at least one reference signal; storing the

abstract of the at least one reference signal in a reference database; receiving at least one query signal to be analyzed; creating an abstract of the at least one query signal; and comparing the abstract of the at least one query signal to the abstract of the at least one reference signal to determine if the abstract of the at least one query signal matches the abstract of the at least one reference signal.

A method for monitoring a plurality of reference signals is also disclosed, which method comprises the steps of: creating an abstract for each one of a plurality of reference signals; storing each of the abstracts in a reference database; receiving at least one query signal to be analyzed; creating an abstract of each at least one query signal; locating an abstract in the reference database that matches the abstract of each at least one query signal; and recording the identify of the reference signal whose abstract matched the abstract of each at least one query signal.

A computerized system for monitoring and analyzing at least one signal is also disclosed, which system comprises: a processor for creating an abstract of a signal using selectable criteria; a first input for receiving at least one reference signal to be monitored, the first input being coupled to the processor such that the processor may generate an abstract for each reference signal input to the processor; a reference database, coupled to the processor, for storing abstracts of each at least one reference signal; a second input for receiving at least one query signal to be analyzed, the second input being coupled to the processor such that the processor may generate an abstract for each query signal; and a comparing device, coupled to the reference database and to the second input, for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

Further, an electronic system for monitoring and analyzing at least one signal is disclosed, which system comprises: a first input for receiving at least one reference signal to be monitored, a first processor for creating an abstract of each reference signal input to the first processor through the first input; a second input for receiving at least one query signal to be analyzed, a second processor for creating an abstract of each query signal; a reference database for storing abstracts of each at least one reference signal; and a comparing device for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

DETAILED DESCRIPTION OF THE INVENTION

While there are many approaches to data reduction that can be utilized, a primary concern is the ability to reduce the digital signal in such a manner as to retain a "perceptual relationship" between the original signal and its data reduced version. This relationship may either be mathematically discernible or a result of market-dictated needs. The purpose is to afford a more consistent means for classifying signals than proprietary, related text-based approaches. A simple analogy is the way in which a forensic investigator uses a sketch artist to assist in determining the identity of a human.

In one embodiment of the invention, the abstract of a signal may be generated by the following steps: 1) analyze the characteristics of each signal in a group of audible/perceptible variations for the same signal (e.g., analyze each of five versions of the same song—which versions may have the same lyrics and music but which are sung by different artists); and 2) select those characteristics which achieve remain relatively constant (or in other words, which have minimum variation) for each of the signals in the group. Optionally, the null case may be defined using those characteristics which are common to each member of the group of versions.

Lossless and lossy compression schemes are appropriate candidates for data reduction technologies, as are those subset of approaches that are based on perceptual models, such as AAC, MP3, TwinVQ, JPEG, GIF, MPEG, etc. Where spectral transforms fail to assist in greater data reduction of the signal, other signal characteristics can be identified as candidates for further data reduction. Linear predictive coding (LPC), z-transform analysis, root mean square (rms), signal to peak, may be appropriate tools to measure signal characteristics, but other approaches or combinations of signal characteristic analysis are contemplated. While such signal characteristics may assist in determining particular applications of the present invention, a generalized approach to signal recognition is necessary to optimize the deployment and use of the present invention.

Increasingly, valuable information is being created and stored in digital form. For example, music, photographs and motion pictures can all be stored and transmitted as a series of binary digits—1's and 0's. Digital techniques permit the original information to be duplicated repeatedly with perfect or near perfect accuracy, and each copy is perceived by viewers or listeners as indistinguishable from the original signal. Unfortunately, digital techniques also permit the information to be easily copied without the owner's permission. While digital representations of analog waveforms may be analyzed by perceptually-based or perceptually-limited analysis it is usually costly and time-consuming to model the processes of the highly effective ability of humans to identify and recognize a signal. In those applications where analog signals require analysis, the cost of digitizing the analog signal is minimal when compared to the benefits of increased accuracy and speed of signal analysis and monitoring when the processes contemplated by this invention are utilized.

The present invention relates to identification of digitally-sampled information, such as images, audio and video. Traditional methods of identification and monitoring of those signals do not rely on "perceptual quality," but rather upon a separate and additional signal. Within this application, such signals will be called "additive signals" as they provide information about the original images, audio or video, but such information is in addition to the original signal. One traditional, text-based additive signal is title and author information. The title and author, for example, is information about a book, but it is in addition to the text of the book. If a book is being duplicated digitally, the title and author could provide one means of monitoring the number of times the text is being duplicated, for example, through an Internet download. The present invention, however, is directed to the identification of a digital signal—whether text, audio, or video—using only the digital signal itself and then monitoring the number of times the signal is duplicated. Reliance on an additive signal has many shortcomings. For example, first, someone must incorporate the additive signal within the digital data being transmitted, for example, by concatenation or through an embedding process. Such an additive signal, however, can be easily identified and removed by one who wants to utilize the original signal without paying for its usage. If the original signal itself is used to identify the content, an unauthorized user could not

avoid payment of a royalty simply by removing the additive signal—because there is no additive signal to remove. Hence, the present invention avoids a major disadvantage of the prior art.

One such additive signal that may be utilized is a digital watermark—which ideally cannot be removed without perceptually altering the original signal. A watermark may also be used as a monitoring signal (for example, by encoding an identifier that uniquely identifies the original digital signal into which the identifier is being embedded). A digital watermark used for monitoring is also an additive signal, and such a signal may make it difficult for the user who wants to duplicate a signal without paying a royalty—mainly by degrading the perceptual quality of the original signal if the watermark (and hence the additive monitoring signal) is removed. This is, however, is a different solution to the problem.

The present invention eliminates the need of any additive monitoring signal because the present invention utilizes the underlying content signal as the identifier itself. Nevertheless, the watermark may increase the value of monitoring techniques by increasing the integrity of the embedded data and by indicating tampering of either the original content signal or the monitoring signal. Moreover, the design of a watermarking embedding algorithm is closely related to the perceptibility of noise in any given signal and can represent an ideal subset of the original signal: the watermark bits are an inverse of the signal to the extent that lossy compression schemes, which can be used, for instance, to optimize a watermarking embedding scheme, can yield information about the extent to which a data signal can be compressed while holding steadfast to the design requirement that the compressed signal maintain its perceptual relationship with the original, uncompressed signal. By describing those bits that are candidates for imperceptible embedding of watermark bits, further data reduction may be applied on the candidate watermarks as an example of retaining a logical and perceptible relationship with the original uncompressed signal.

Of course, the present invention may be used in conjunction with watermarking technology (including the use of keys to accomplish secure digital watermarking), but watermarking is not necessary to practice the present invention. Keys for watermarking may have many forms, including: descriptions of the original carrier file formatting, mapping of embedded data (actually imperceptible changes made to the carrier signal and referenced to the predetermined key or key pairs), assisting in establishing the watermark message data integrity (by incorporation of special one way functions in the watermark message data or key), etc. Discussions of these systems in the patents and pending patent applications are incorporated by reference above. The "recognition" of a particular signal or an instance of its transmission, and its monitoring are operations that may be optimized through the use of digital watermark analysis.

A practical difference between the two approaches of using a separate, additive monitoring signal and using the original signal itself as the monitoring signal is control. If a separate signal is used for monitoring, then the originator of the text, audio or video signal being transmitted and the entity doing the monitoring have to agree as to the nature of the separate signal to be used for monitoring—otherwise, the entity doing the monitoring would not know where to look, for what to look, or how to interpret the monitoring signal once it was identified and detected. On the other hand, if the original signal is used itself as a monitoring signal, then no such agreement is necessary. Moreover, a more logical and self-sufficient relationship between the original and its data-reduced abstract enhances the transparency of any resulting monitoring efforts. The entity doing the monitoring is not looking for a separate, additive monitoring system, and further, need not have to interpret the content of the monitoring signal.

Monitoring implementations can be handled by robust watermark techniques (those techniques that are able to survive many signal manipulations but are not inherently "secure" for verification of a carrier signal absent a logically-related watermarking key) and forensic watermark techniques (which enable embedding of watermarks that are not able to survive perceptible alteration of the carrier signal and thus enable detection of tampering with the originally watermarked carrier signal). The techniques have obvious trade-offs between speed, performance and security of the embedded watermark data.

In other disclosures, we suggest improvements and implementations that relate to digital watermarks in particular and embedded signaling in general. A digital watermark may be used to "tag" content in a manner that is not humanly-perceptible, in order to ensure that the human perception of the signal quality is maintained. Watermarking, however, must inherently alter at least one data bit of the original signal to represent a minimal change from the original signal's "unwatermarked state." The changes may affect only a bit, at the very least, or be dependent on information hiding relating to signal characteristics, such as phase information, differences between digitized samples, root mean square (RMS) calculations, z-transform analysis, or similar signal characteristic category.

There are weaknesses in using digital watermark technology for monitoring purposes. One weakness relates directly to the way in which watermarks are implemented. Often, the persons responsible for encoding and decoding the digital watermark are not the creator of the valuable work to be protected. As such, the creator has no input on the placement of the monitoring signal within the valuable work being protected. Hence, if a user wishing to avoid payment of the royalty can find a way to decode or remove the watermark, or at least the monitoring signal embedded in the watermark, then the unauthorized user may successfully duplicate the signal with impunity. This could occur, for example, if either of the persons responsible for encoding or decoding were to have their security compromised such that the encoding or decoding algorithms were discovered by the unauthorized user.

With the present invention, no such disadvantages exist because the creator need not rely on anyone to insert a monitoring signal—as no such signal is necessary. Instead, the creator's work itself is used as the monitoring signal. Accordingly, the value in the signal will have a strong relationship with its recognizability.

By way of improving methods for efficient monitoring as well as effective confirmation of the identity of a digitally-sampled signal, the present invention describes useful methods for using digital signal processing for benchmarking a novel basis for differencing signals with binary data comparisons. These techniques may be complemented with perceptual techniques, but are intended to leverage the generally decreasing cost of bandwidth and signal processing power in an age of increasing availability and exchange of digitized binary data.

So long as there exist computationally inexpensive ways of identifying an entire signal with some fractional representation or relationship with the original signal, or its perceptually observable representation, we envision meth-

ods for faster and more accurate auditing of signals as they are played, distributed or otherwise shared amongst providers (transmitters) and consumers (receivers). The ability to massively compress a signal to its essence—which is not strictly equivalent to "lossy" or "lossless" compression schemes or perceptual coding techniques, but designed to preserve some underlying "aesthetic quality" of the signal—represents a useful means for signal analysis in a wide variety of applications. The signal analysis, however, must maintain the ability to distinguish the perceptual quality of the signals being compared. For example, a method which analyzed a portion of a song by compressing it to a single line of lyrics fails to maintain the ability to distinguish the perceptual quality of the songs being compared. Specifically, for example, if the song "New York State of Mind" were compressed to the lyrics "I'm in a New York State of Mind," such a compression fails to maintain the ability to distinguish between the various recorded versions of the song, say, for example between Billy Joel's recording and Barbara Streisand's recording. Such a method is, therefore, incapable of providing accurate monitoring of the artist's recordings because it could not determine which of the two artists is deserving of a royalty—unless of course, there is a separate monitoring signal to provide the name of the artist or other information sufficient to distinguish the two versions. The present invention, however, aims to maintain some level of perceptual quality of the signals being compared and would deem such a compression to be excessive.

This analogy can be made clearer if it is understood that there are a large number of approaches to compressing a signal to, say, $\frac{1}{10{,}000}^{th}$ of its original size, not for maintaining its signal quality to ensure computational ease for commercial quality distribution, but to assist in identification, analysis or monitoring of the signal. Most compression is either lossy or lossless and is designed with psychoacoustic or psychovisual parameters. That is to say, the signal is compressed to retain what is "humanly-perceptible." As long as the compression successfully mimics human perception, data space may be saved when the compressed file is compared to the uncompressed or original file. While psychoacoustic and psychovisual compression has some relevance to the present invention, additional data reduction or massive compression is anticipated by the present invention. It is anticipated that the original signal may be compressed to create a realistic or self-similar representation of the original signal, so that the compressed signal can be referenced at a subsequent time as unique binary data that has computational relevance to the original signal. Depending on the application, general data reduction of the original signal can be as simple as massive compression or may relate to the watermark encoding envelope parameter (those bits which a watermarking encoding algorithm deem as candidate bits for mapping independent data or those bits deemed imperceptible to human senses but detectable to a watermark detection algorithm). In this manner, certain media which are commonly known by signal characteristics, a painting, a song, a TV commercial, a dialect, etc., may be analyzed more accurately, and perhaps, more efficiently than a text-based descriptor of the signal. So long as the sender and receiver agree that the data representation is accurate, even insofar as the data-reduction technique has logical relationships with the perceptibility of the original signal, as they must with commonly agreed to text descriptors, no independent cataloging is necessary.

The present invention generally contemplates a signal recognition system that has at least five elements. The actual number of elements may vary depending on the number of

domains in which a signal resides (for example, audio is at least one domain while visual carriers are at least two dimensional). The present invention contemplates that the number of elements will be sufficient to effectively and efficiently meet the demands of various classes of signal recognition. The design of the signal recognition that may be used with data reduction is better understood in the context of the general requirements of a pattern or signal recognition system.

The first element is the reference database, which contains information about a plurality of potential signals that will be monitored. In one form, the reference database would contain digital copies of original works of art as they are recorded by the various artists, for example, contain digital copies of all songs that will be played by a particular radio station. In another form, the reference database would contain not perfect digital copies of original works of art, but digital copies of abstracted works of art, for example, contain digital copies of all songs that have been preprocessed such that the copies represent the perceptual characteristics of the original songs. In another form, the reference database would contain digital copies of processed data files, which files represent works of art that have been preprocessed in such a fashion as to identify those perceptual differences that can differentiate one version of a work of art from another version of the same work of art, such as two or more versions of the same song, but by different artists. These examples have obvious application to visually communicated works such as images, trademarks or photographs, and video as well.

The second element is the object locator, which is able to segment a portion of a signal being monitored for analysis (i.e., the "monitored signal"). The segmented portion is also referred to as an "object." As such, the signal being monitored may be thought of comprising a set of objects. A song recording, for example, can be thought of as having a multitude of objects. The objects need not be of uniform length, size, or content, but merely be a sample of the signal being monitored. Visually communicated informational signals have related objects; color and size are examples.

The third element is the feature selector, which is able to analyze a selected object and identify perceptual features of the object that can be used to uniquely describe the selected object. Ideally, the feature selector can identify all, or nearly all, of the perceptual qualities of the object that differentiate it from a similarly selected object of other signals. Simply, a feature selector has a direct relationship with the perceptibility of features commonly observed. Counterfeiting is an activity which specifically seeks out features to misrepresent the authenticity of any given object. Highly granular, and arguably successful, counterfeiting is typically sought for objects that are easily recognizable and valuable, for example, currency, stamps, and trademarked or copyrighted works and objects that have value to a body politic.

The fourth element is the comparing device which is able to compare the selected object using the features selected by the feature selector to the plurality of signals in the reference database to identify which of the signals matches the monitored signal. Depending upon how the information of the plurality of signals is stored in the reference database and depending upon the available computational capacity (e.g., speed and efficiency), the exact nature of the comparison will vary. For example, the comparing device may compare the selected object directly to the signal information stored in the database. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector and then compare the

selected object to the processed signal information. Alternatively, the comparing device may need to process the selected object using input from the feature selector and then compare the processed selected object to the signal information. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector, process the selected object using input from the feature selector, and then compare the processed selected object to the processed signal information.

The fifth element is the recorder which records information about the number of times a given signal is analyzed and detected. The recorder may comprise a database which keeps track of the number of times a song, image, or a movie has been played, or may generate a serial output which can be subsequently processed to determine the total number of times various signals have been detected.

Other elements may be added to the system or incorporated into the five elements identified above. For example, an error handler may be incorporated into the comparing device. If the comparing device identifies multiple signals which appear to contain the object being sought for analysis or monitoring, the error handler may offer further processing in order to identify additional qualities or features in the selected object such that only one of the set of captured signals is found to contain the further analyzed selected object that actually conforms with the object thought to have been transmitted or distributed.

Moreover, one or more of the five identified elements may be implemented with software that runs on the same processor, or which uses multiple processors. In addition, the elements may incorporate dynamic approaches that utilize stochastic, heuristic, or experience-based adjustments to refine the signal analysis being conducted within the system, including, for example, the signal analyses being performed within the feature selector and the comparing device. This additional analyses may be viewed as filters that are designed to meet the expectations of accuracy or speed for any intended application.

Since maintenance of original signal quality is not required by the present invention, increased efficiencies in processing and identification of signals can be achieved. The present invention concerns itself with perceptible relationships only to the extent that efficiencies can be achieved both in accuracy and speed with enabling logical relationships between an original signal and its abstract.

The challenge is to maximize the ability to sufficiently compress a signal to both retain its relationship with the original signal while reducing the data overhead to enable more efficient analysis, archiving and monitoring of these signals. In some cases, data reduction alone will not suffice: the sender and receiver must agree to the accuracy of the recognition. In other cases, agreement will actually depend on a third party who authored or created the signal in question. A digitized signal may have parameters to assist in establishing more accurate identification, for example, a "signal abstract" which naturally, or by agreement with the creator, the copyright owner or other interested parties, can be used to describe the original signal. By utilizing less than the original signal, a computationally inexpensive means of identification can be used. As long as a realistic set of conditions can be arrived at governing the relationship between a signal and its data reduced abstract, increases in effective monitoring and transparency of information data flow across communications channels is likely to result. This feature is significant in that it represents an improvement over how a digitally-sampled signal can be cataloged and identified, though the use of a means that is specifically selected based upon the strengths of a general computing device and the economic needs of a particular market for the digitized information data being monitored. The additional benefit is a more open means to uniformly catalog, analyze, and monitor signals. As well, such benefits can exist for third parties, who have a significant interest in the signal but are not the sender or receiver of said information.

As a general improvement over the art, the present invention incorporates what could best be described as "computer-acoustic" and "computer-visual" modeling, where the signal abstracts are created using data reduction techniques to determine the smallest amount of data, at least a single bit, which can represent and differentiate two digitized signal representations for a given predefined signal set. Each of such representations must have at least a one bit difference with all other members of the database to differentiate each such representation from the others in the database. The predefined signal set is the object being analyzed. The signal identifier/detector should receive its parameters from a database engine. The engine will identify those characteristics (for example, the differences) that can be used to distinguish one digital signal from all other digital signals that are stored in its collection. For those digital signals or objects which are seemingly identical, excepting that the signal may have different performance or utilization in the newly created object, benefits over additive or text-based identifiers are achieved. Additionally, decisions regarding the success or failure of an accurate detection of any given object may be flexibly implemented or changed to reflect market-based demands of the engine. Appropriate examples are songs or works or art which have been sampled or re-produced by others who are not the original creator.

In some cases, the engine will also consider the NULL case for a generalized item not in its database, or perhaps in situations where data objects may have collisions. For some applications, the NULL case is not necessary, thus making the whole system faster. For instance, databases which have fewer repetitions of objects or those systems which are intended to recognize signals with time constraints or capture all data objects. Greater efficiency in processing a relational database can be obtained because the rules for comparison are selected for the maximum efficiency of the processing hardware and/or software, whether or not the processing is based on psychoacoustic or psychovisual models. The benefits of massive data reduction, flexibility in constructing appropriate signal recognition protocols and incorporation of cryptographic techniques to further add accuracy and confidence in the system are clearly improvements over the art. For example, where the data reduced abstract needs to have further uniqueness, a hash or signature may be required. And for objects which have further uniqueness requirements, two identical instances of the object could be made unique with cryptographic techniques.

Accuracy in processing and identification may be increased by using one or more of the following fidelity evaluation functions:

1) RMS (root mean square). For example, a RMS function may be used to assist in determining the distance between data based on mathematically determinable Euclidean distance between the beginning and end data points (bits) of a particular signal carrier.
2) Frequency weighted RMS. For example, different weights may be applied to different frequency components of the carrier signal before using RMS. This selective weighting can assist in further distinguishing the distance between beginning and end points of the

signal carrier (at a given point in time, described as bandwidth, or the number of total bits that can be transmitted per second) and may be considered to be the mathematical equivalent of passing a carrier signal difference through a data filter and figuring the average power in the output carrier.

3) Absolute error criteria, including particularly the NULL set (described above) The NULL may be utilized in two significant cases: First, in instances where the recognized signal appears to be an identified object which is inaccurately attributed or identified to an object not handled by the database of objects; and second, where a collision of data occurs. For instance, if an artist releases a second performance of a previously recorded song, and the two performances are so similar that their differences are almost imperceptible, then the previously selected criteria may not be able to differentiate the two recordings. Hence, the database must be "recalibrated" to be able to differentiate these two versions. Similarly, if the system identifies not one, but two or more, matches for a particular search, then the database may need "recalibration" to further differentiate the two objects stored in the database.

4) Cognitive Identification. For example, the present invention may use an experience-based analysis within a recognition engine. Once such analysis may involve mathematically determining a spectral transform or its equivalent of the carrier signal. A spectral transform enables signal processing and should maintain, for certain applications, some cognitive or perceptual relationship with the original analog waveform. As a novel feature to the present invention, additional classes may be subject to humanly-perceptible observation. For instance, an experience-based criteria which relates particularly to the envisioned or perceived accuracy of the data information object as it is used or applied in a particular market, product, or implementation. This may include a short 3 second segment of a commercially available and recognizable song which is used for commercials to enable recognition of the good or service being marketed. The complete song is marketed as a separately valued object from the use of a discrete segment of the song (that may be used for promotion or marketing—for the complete song or for an entirely different good or service). To the extent that an owner of the song in question is able to further enable value through the licensing or agreement for use of a segment of the original signal, cognitive identification is a form of filtering to enable differentiations between different and intended uses of the same or subset of the same signal (object). The implementation relating specifically, as disclosed herein, to the predetermined identification or recognition means and/or any specified relationship with subsequent use of the identification means can be used to create a history as to how often a particular signal is misidentified, which history can then be used to optimize identification of that signal in the future. The difference between use of an excerpt of the song to promote a separate and distinct good or service and use of the excerpt to promote recognition of the song itself (for example, by the artist to sell copies of the song) relates informationally to a decision based on recognized and approved use of the song. Both the song and applications of the song in its entirety or as a subset are typically based on agreement by the creator and the sender who seeks to utilize the work. Trust in the means for identification, which can be weighted in the present invention (for example, by adjusting bit-addressable information), is an important factor in adjusting the monitoring or recognition features of the object or carrier signal, and by using any misidentification information, (including any experience-based or heuristic information), additional features of the monitored signal can be used to improve the performance of the monitoring system envisioned herein. The issue of central concern with cognitive identification is a greater understanding of the parameters by which any given object is to be analyzed. To the extent that a creator chooses varying and separate application of his object, those applications having a cognitive difference in a signal recognition sense (e.g., the whole or an excerpt), the system contemplated herein includes rules for governing the application of bit-addressable information to increase the accuracy of the database.

5) Finally, the predetermined parameters that are associated with a discrete case for any given object will have a significant impact upon the ability to accurately process and identify the signals. For example, if a song is transmitted over a FM carrier, then one skilled in the art will appreciate that the FM signal has a predetermined bandwidth which is different from the bandwidth of the original recording, and different even from song when played on an AM carrier, and different yet from a song played using an 8-bit Internet broadcast. Recognition of these differences, however, will permit the selection of an identification means which can be optimized for monitoring a FM broadcasted signal. In other words, the discreteness intended by the sender is limited and directed by the fidelity of the transmission means. Objects may be cataloged and assessing with the understanding that all monitoring will occur using a specific transmission fidelity. For example, a database may be optimized with the understanding that only AM broadcast signals will be monitored. For maximum efficiency, different data bases may be created for different transmission channels, e.g., AM broadcasts, FM broadcasts, Internet broadcasts, etc.

For more information on increasing efficiencies for information systems, see *The Mathematical Theory of Communication* (1948), by Shannon.

Because bandwidth (which in the digital domain is equated to the total number of bits that can be transmitted in a fixed period of time) is a limited resource which places limitations upon transmission capacity and information coding schemes, the importance of monitoring for information objects transmitted over any given channel must take into consideration the nature and utilization of a given channel. The supply and demand of bandwidth will have a dramatic impact on the transmission, and ultimately, upon the decision to monitor and recognize signals. A discussion of this is found in a co-pending application by the inventor under U.S. patent application Ser. No. 08/674,726 "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (which application is incorporated herein by reference as if fully setforth herein).

If a filter is to be used in connection with the recognition or monitoring engine, it may be desirable for the filter to anticipate and take into consideration the following factors, which affect the economics of the transmission as they relate to triggers for payment and/or relate to events requiring audits of the objects which are being transmitted: 1) time of transmission (i.e., the point in time when the transmission

occurred), including whether the transmission is of a live performance); 2) location of transmission (e.g., what channel was used for transmission, which usually determines the associated cost for usage of the transmission channel); 3) the point of origination of the transmission (which may be the same for a signal carrier over many distinct channels); and 4) pre-existence of the information carrier signal (prerecorded or newly created information carrier signal, which may require differentiation in certain markets or instances).

In the case of predetermined carrier signals (those which have been recorded and stored for subsequent use), "positional information carrier signals" are contemplated by this invention, namely, perceptual differences between the seemingly "same" information carrier that can be recognized as consumers of information seek different versions or quality levels of the same carrier signal. Perceptual differences exist between a song and its reproduction from a CD, an AM radio, and an Internet broadcast. To the extent that the creator or consumer of the signal can define a difference in any of the four criteria above, means can be derived (and programmed for selectability) to recognize and distinguish these differences. It is, however, quite possible that the ability to monitor carrier signal transmission with these factors will increase the variety and richness of available carrier signals to existing communications channels. The differentiation between an absolute case for transmission of an object, which is a time dependent event, for instance a live or real time broadcast, versus the relative case, which is prerecorded or stored for transmission at a later point in time, creates recognizable differences for signal monitoring.

The monitoring and analysis contemplated by this invention may have a variety of purposes, including, for example, the following: to determine the number of times a song is broadcast on a particular radio broadcast or Internet site; to control security though a voice-activated security system; and to identify associations between a beginner's drawing and those of great artists (for example to draw comparisons between technique, compositions, or color schemes). None of these examples could be achieved with any significant degree of accuracy using a text-based analysis. Additionally, strictly text-based systems fail to fully capture the inherent value of the data recognition or monitoring information itself.

SAMPLE EMBODIMENTS

In order to better appreciate and understand the present invention, the following sample embodiments are provided. These sample embodiments are provided for exemplary purposes only, and in no way limit the present invention.

Sample Embodiment 1

A database of audio signals (e.g., songs) is stored or maintained by a radio station or Internet streaming company, who may select a subset of the songs are stored so that the subset may be later broadcast to listeners. The subset, for example, may comprise a sufficient number of songs to fill 24 hours of music programming (between 300 or 500 songs). Traditionally, monitoring is accomplished by embedding some identifier into the signal, or affixing the identifier to the signal, for later analysis and determination of royalty payments. Most of the traditional analysis is performed by actual persons who use play lists and other statistical approximations of audio play, including for example, data obtained through the manual (i.e., by persons) monitoring of a statistically significant sample of stations and transmission times so that an extrapolation may be made to a larger number of comparable markets.

The present invention creates a second database from the first database, wherein each of the stored audio signals in the first database is data reduced in a manner that is not likely to reflect the human perceptual quality of the signal, meaning that a significantly data-reduced signal is not likely to be played back and recognized as the original signal. As a result of the data reduction, the size of the second database (as measured in digital terms) is much smaller than the size of the first database, and is determined by the rate of compression. If, for example, if 24 hours worth of audio signals are compressed at a 10,000:1 compression rate, the reduced data could occupy a little more than 1 megabyte of data. With such a large compression rate, the data to be compared and/or analyzed may become computationally small such that computational speed and efficiency are significantly improved.

With greater compression rates, it is anticipated that similarity may exist between the data compressed abstractions of different analog signals (e.g., recordings by two different artists of the same song). The present invention contemplates the use of bit-addressable differences to distinguish between such cases. In applications where the data to be analyzed has higher value in some predetermined sense, cryptographic protocols, such as a hash or digital signature, can be used to distinguish such close cases.

In a preferred embodiment, the present invention may utilize a centralized database where copies of new recordings may be deposited to ensure that copyright owners, who authorize transmission or use of their recordings by others, can independently verify that the object is correctly monitored. The rules for the creator himself to enter his work would differ from a universally recognized number assigned by an independent authority (say, ISRC, ISBN for recordings and books respectively). Those skilled in the art of algorithmic information theory (AIT) can recognize that it is now possible to describe optimized use of binary data for content and functionality. The differences between objects must relate to decisions made by the user of the data, introducing subjective or cognitive decisions to the design of the contemplated invention as described above. To the extent that objects can have an optimized data size when compared with other objects for any given set of objects, the algorithms for data reduction would have predetermined flexibility directly related to computational efficiency and the set of objects to be monitored. The flexibility in having transparent determination of unique signal abstracts, as opposed to independent third party assignment, is likely to increase confidence in the monitoring effort by the owners of the original signals themselves. The prior art allows for no such transparency to the copyright creators.

Sample Embodiment 2

Another embodiment of the invention relates to visual images, which of course, involve at least two dimensions.

Similar to the goals of a psychoacoustic model, a psychovisual model attempts to represent a visual image with less data, and yet preserve those perceptual qualities that permit a human to recognize the original visual image. Using the very same techniques described above in connection with an audio signal, signal monitoring of visual images may be implemented.

One such application for monitoring and analyzing visual images involves a desire to find works of other artists that relate to a particular theme. For example, finding paintings

of sunsets or sunrises. A traditional approach might involve a textual search involving a database wherein the works of other artists have been described in writing. The present invention, however, involves the scanning of an image involving a sun, compressing the data to its essential characteristics (i.e., those perceptual characteristics related to the sun) and then finding matches in a database of other visual images (stored as compressed or even uncompressed data). By studying the work of other artists using such techniques, a novice, for example, could learn much by comparing the presentations of a common theme by different artists.

Another useful application involving this type of monitoring and analyzing is the identification of photographs of potential suspects whose identity matches the sketch of a police artist.

Note that combinations of the monitoring techniques discussed above can be used for audio-visual monitoring, such as video-transmission by a television station or cable station. The techniques would have to compensate, for example, for a cable station that is broadcasting a audio channel unaccompanied by video.

Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The specification and examples should be considered exemplary only with the true scope and spirit of the invention indicated by the following claims. As will be easily understood by those of ordinary skill in the art, variations and modifications of each of the disclosed embodiments can be easily made within the scope of this invention as defined by the following claims.

What is claimed is:

1. A method for monitoring and analyzing at least one signal comprising:

receiving at least one reference signal to be monitored;

creating an abstract of said at least one reference signal wherein the step of creating an abstract of said at least one reference signal comprises:

inputting the reference signal to a processor;

creating an abstract of the reference signal using perceptual qualities of the reference signal such that the abstract retains a perceptual relationship to the reference signal from which it is derived;

storing the abstract of said at least one reference signal in a reference database;

receiving at least one query signal to be analyzed;

creating an abstract of said at least one query signal wherein the step of creating an abstract of said at least one query signal comprises:

inputting the at least one query signal to the processor;

creating an abstract of the at least one query signal using perceptual qualities of the at least one query signal such that the abstract retains a perceptual relationship to the at least one query signal from which it is derived; and

comparing the abstract of said at least one query signal to the abstract of said at least one reference signal to determine if the abstract of said at least one query signal matches the abstract of said at feast one reference signal.

2. The method of claim **1**, wherein the step of creating an abstract of said at least one reference signal comprises:

using a portion of said at least one reference signal to create an abstract of said at least one reference signal; and

the step of creating an abstract of said at least one query signal comprises:

using a portion of said at least one query signal to create an abstract of said at least one query signal.

3. A method for monitoring and analyzing at least one signal comprising:

receiving at least one reference signal to be monitored;

creating an abstract of said at least one reference signal;

storing the abstract of said at least one reference signal in a reference database;

receiving at least one query signal to be analyzed;

creating an abstract of said at least one query signal;

comparing the abstract of said at least one query signal to the abstract of said at least one reference signal to determine if the abstract of said at least one query signal matches the abstract of said at least one reference signal;

creating at least one counter corresponding to one of said at least one reference signals, said at least one counter being representative of the number of times a match is found between the abstract of said at least one query signal and the abstract of said at least one reference signal; and

incrementing the counter corresponding to a particular reference signal when a match is found between an abstract of said at least one query signal and the abstract of the particular reference signal.

4. The method of claim **3** further comprising:

recording an occurrence of a match between the abstract of said at least one query signal and the abstract of said at least one reference signal; and

generating a report that identifies the reference signal whose abstract matched the abstract of said at least one query signal.

5. The method of claim **4**, further comprising:

recording an occurrence of a match between the abstract of said at least one query signal and the abstract of said at least one reference signal.

6. A method for monitoring a plurality of reference signals, comprising:

creating an abstract for each of the plurality of reference signals wherein the step of creating an abstract for each of a plurality of reference signals comprises:

inputting each of the plurality of reference signals to a processor;

creating an abstract of each one of the plurality of reference signals using perceptual qualities of each one of a plurality of reference signals such that the abstract retains a perceptual relationship to the reference signal from which it is derived;

storing each of said abstracts in a reference database;

receiving at least one query signal to be analyzed;

creating an abstract of each of the at least one query signals wherein the step of creating an abstract of each of the at least one query signals comprises:

inputting each of the at least one query signals to a processor;

creating an abstract of each one of a plurality of reference signals using perceptual qualities of each one of a plurality of reference signals such that the abstract retains a perceptual relationship to the reference signal from which it is derived;

locating an abstract in the reference database that matches the abstract of each at least one query signal; and

recording the identify of the reference signal whose abstract matched the abstract of each at least one query signal.

7. The method of claim 6, wherein

the step of creating an abstract of said at least one reference signal comprises:

using a portion of said at least one reference signal to create an abstract of said at least one reference signal;

and the step of creating an abstract of said at least one query signal comprises:

using a portion of said at least one query signal to create an abstract of said at least one query signal.

8. A method for monitoring a plurality of reference signals, comprising:

creating an abstract for each of the plurality of reference signals;

storing each of said abstracts in a reference database;

receiving at least one query signal to be analyzed;

creating an abstract of each of the at least one query signals;

locating an abstract in the reference database that matches the abstract of each at least one query signal;

recording the identify of the reference signal whose abstract matched the abstract of each at least one query signal;

creating at least one counter corresponding to one of said plurality of reference signals, said at least one counter being representative of the number of times a match is found between the abstract of said at least one query signal and an abstract of one of said plurality of reference signals; and

incrementing the counter corresponding to a particular reference signal when a match is found between an abstract of said at least one query signal and the abstract of the particular reference signal.

9. A computerized system for monitoring and analyzing at least one signal:

a processor that creates an abstract of a signal using selectable criteria;

a first input that receives at least one reference signal to be monitored, said first input being coupled to said processor such that said processor may generate an abstract for each reference signal input to said processor;

a reference database, coupled to said processor, that stores abstracts of each at least one reference signal;

a second input that receives at least one query signal to be analyzed, said second input being coupled to said processor such that said processor may generate an abstract for each query signal;

a comparing device, coupled to said reference database and to said second input, that compares an abstract of said at least one query signal to the abstracts stored in the reference database to determine if the abstract of said at least one query signal matches any of the stored abstracts;

a storage medium coupled to said first input, that stores each of said at least one reference signals to be monitored; and

a controller coupled to the first input, the processor, the comparing device, the reference database and the storage medium, said controller causing an abstract for each reference signal being input for the first time to be compared to all previously stored abstracts in the reference database, such that in the event that the comparing device determines that it cannot distinguish between the abstract of a reference signal being input for the first time from a previously stored abstract in the reference database, the controller adjusts the criteria being used by the processor and re-generates the reference database, by re-processing each reference signal stored on the storage medium to create new abstracts and storing said new abstracts in the reference database.

10. The system of claim 9, wherein the controller includes a means to adjust compression rates at which the processor processes a signal to create an abstract.

11. A computerized system for monitoring and analyzing at least one signal:

a processor that creates an abstract of a signal using selectable criteria;

a first input that receives at least one reference signal to be monitored, said first input being coupled to said processor such that said processor may generate an abstract for each reference signal input to said processor;

a reference database, coupled to said processor, that stores abstracts of each at least one reference signal;

a second input that receives at least one query signal to be analyzed, said second input being coupled to said processor such that said processor may generate an abstract for each query signal;

a comparing device, coupled to said reference database and to said second input, that compares an abstract of said at least one query signal to the abstracts stored in the reference database to determine if the abstract of said at least one query signal matches any of the stored abstracts, wherein the comparing device identifies at least two abstracts in the reference database that match the abstract of said at least one query signal and an index of relatedness to said at least one query signal for each of said at least two matching abstracts.

12. The system of claim 11, further comprising:

a security controller that controls access to a secured area, such that access is granted only if the comparing device confirms that an abstract of said at least one query signal matches an abstract of said at least one reference signal.

13. The system of claim 11, further comprising:

a recorder that records the identify of the reference signal whose abstract matched the abstract of said at least one query signal; and

a report generator that generates a report that identifies the reference signals whose abstracts matched the abstract of said at least one query signal.

14. A electronic system for monitoring and analyzing at least one signal, comprising:

a first input that receives at least one reference signal to be monitored,

a first processor that creates an abstract of each reference signal input to said first processor through said first input;

a second input that receives at least one query signal to be analyzed,

a second processor that creates an abstract of each query signal;

a reference database that stores abstracts of each at least one reference signal;

a comparing device that compares an abstract of said at least one query signal to the abstracts stored in the reference database to determine if the abstract of said at least one query signal matches any of the stored abstracts;

a storage medium coupled to said first input, that stores each of said at least one reference signals to be monitored; and

a controller that compares an abstract for each reference signal being input for the first time to be compared to all previously stored abstracts in the reference database, such that in the event that the comparing device determines that it cannot distinguish between the abstract of a reference signal being input for the first time from a previously stored abstract in the reference database, the controller adjusts the criteria being used by the processor and re-generates the reference database, by re-processing each reference signal stored on the storage medium to create new abstracts and storing said new abstracts in the reference database.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,346,472 B1
APPLICATION NO. : 09/657181
DATED : March 18, 2008
INVENTOR(S) : Scott Moskowitz

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1 line 7 reading:
-- This application claims the benefit of pending U.S. patent --

should read:

-- This application is related to pending U.S. patent --

Signed and Sealed this
Thirteenth Day of September, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

US007660700B2

(12) **United States Patent**
Moskowitz et al.

(10) **Patent No.: US 7,660,700 B2**
(45) **Date of Patent: *Feb. 9, 2010**

(54) **METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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G06F 19/00 (2006.01)

(52) **U.S. Cl.** **702/182**; 707/1; 707/2; 707/3; 707/10; 709/209; 705/51; 380/28

(58) **Field of Classification Search** 702/182; 707/1, 2, 3, 10; 709/209; 705/51; 380/28
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,947,825	A		3/1976	Cassada
3,984,624	A		10/1976	Waggener
3,986,624	A		10/1976	Cates, Jr. et al.
4,038,596	A		7/1977	Lee
4,200,770	A		4/1980	Hellman et al.
4,218,582	A		8/1980	Hellman et al.
4,339,134	A		7/1982	Macheel
4,390,898	A		6/1983	Bond et al.
4,405,829	A		9/1983	Rivest et al.
4,424,414	A		1/1984	Hellman et al.
4,528,588	A		7/1985	Lofberg
4,672,605	A		6/1987	Hustig et al.
4,748,668	A		5/1988	Shamir et al.
4,789,928	A		12/1988	Fujisaki
4,827,508	A		5/1989	Shear
4,876,617	A		10/1989	Best et al.
4,896,275	A		1/1990	Jackson
4,908,873	A		3/1990	Philibert et al.
4,939,515	A		7/1990	Adelson
4,969,204	A		11/1990	Jones et al.
4,972,471	A		11/1990	Gross et al.
4,977,594	A		12/1990	Shear
4,979,210	A		12/1990	Nagata et al.
4,980,782	A		12/1990	Ginkel
5,050,213	A		9/1991	Shear
5,073,925	A		12/1991	Nagata et al.
5,077,665	A		12/1991	Silverman et al.
5,113,437	A		5/1992	Best et al.
5,136,581	A		8/1992	Muehrcke
5,136,646	A		8/1992	Haber et al.
5,136,647	A		8/1992	Haber et al.
5,142,576	A		8/1992	Nadan
5,161,210	A		11/1992	Druyvesteyn et al.
5,210,820	A	*	5/1993	Kenyon 704/200
5,243,423	A		9/1993	DeJean et al.
5,243,515	A		9/1993	Lee
5,287,407	A		2/1994	Holmes
5,319,735	A		6/1994	Preuss et al.
5,341,429	A		8/1994	Stringer et al.
5,341,477	A		8/1994	Pitkin et al.
5,363,448	A		11/1994	Koopman et al.
5,365,586	A		11/1994	Indeck et al.
5,369,707	A		11/1994	Follendore, III
5,379,345	A		1/1995	Greenberg
5,394,324	A		2/1995	Clearwater
5,398,285	A		3/1995	Borgelt et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0372601 A1 6/1990

(Continued)

OTHER PUBLICATIONS

Schneier, Bruce, Applied Cryptography, 2nd Ed., John Wiley & Sons, pp. 9-10, 1996.

Menezes, Alfred J., Handbook of Applied Crypography, CRC Press, p. 46, 1997.

Brealy, et al., Principles of Corporate Finance, "Appendix A—Using Option Valuation Models", 1984, pp. 448-449 .

Copeland, et al., Real Options:A Practioner's Guide, 2001 pp. 106-107, 201-202, 204-208.

Crawford, D.W. "Pricing Network Usage:A Market for Bandwith of Market Communication?" presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.umich.edu/jep/works/CrawMarket.html on March.

Low, S.H., "Equilibrium Allocation and Pricing of Variable Resources Among User-Suppliers", 1988. http://www.citesear.nj.nec.com/366503.html.

(Continued)

Primary Examiner—Carol S Tsai

(57) **ABSTRACT**

A method and system for monitoring and analyzing at least one signal are disclosed. An abstract of at least one reference signal is generated and stored in a reference database. An abstract of a query signal to be analyzed is then generated so that the abstract of the query signal can be compared to the abstracts stored in the reference database for a match. The method and system may optionally be used to record information about the query signals, the number of matches recorded, and other useful information about the query signals. Moreover, the method by which abstracts are generated can be programmable based upon selectable criteria. The system can also be programmed with error control software so as to avoid the re-occurrence of a query signal that matches more than one signal stored in the reference database.

52 Claims, No Drawings

U.S. PATENT DOCUMENTS

5,406,627	A	4/1995	Thompson et al.
5,408,505	A	4/1995	Indeck et al.
5,410,598	A	4/1995	Shear
5,412,718	A	5/1995	Narasimhalu et al.
5,418,713	A	5/1995	Allen
5,428,606	A	6/1995	Moskowitz
5,450,490	A	9/1995	Jensen et al.
5,469,536	A	11/1995	Blank
5,471,533	A	11/1995	Wang et al.
5,478,990	A	12/1995	Montanari et al.
5,479,210	A	12/1995	Cawley et al.
5,487,168	A	1/1996	Geiner et al.
5,493,677	A	2/1996	Balogh et al.
5,497,419	A	3/1996	Hill
5,506,795	A	4/1996	Yamakawa
5,513,126	A	4/1996	Harkins et al.
5,513,261	A	4/1996	Maher
5,530,739	A	6/1996	Okada
5,530,751	A	6/1996	Morris
5,530,759	A	6/1996	Braudaway et al.
5,548,579	A	8/1996	Lebrun et al.
5,568,570	A	10/1996	Rabbani
5,579,124	A	11/1996	Aijala et al.
5,581,703	A	12/1996	Baugher et al.
5,583,488	A	12/1996	Sala et al.
5,598,470	A	1/1997	Cooper et al.
5,606,609	A	2/1997	Houser et al.
5,613,004	A	3/1997	Cooperman et al.
5,617,119	A	4/1997	Briggs et al.
5,625,690	A	4/1997	Michel et al.
5,629,980	A	5/1997	Stefik et al.
5,633,932	A	5/1997	Davis et al.
5,634,040	A	5/1997	Her et al.
5,636,276	A	6/1997	Brugger
5,636,292	A	6/1997	Rhoads
5,640,569	A	6/1997	Miller et al.
5,646,997	A	7/1997	Barton
5,657,461	A	8/1997	Harkins et al.
5,659,726	A	8/1997	Sandford, II et al.
5,664,018	A	9/1997	Leighton
5,673,316	A	9/1997	Auerbach et al.
5,677,952	A	10/1997	Blakley et al.
5,680,462	A	10/1997	Miller et al.
5,687,236	A	11/1997	Moskowitz et al.
5,689,587	A	11/1997	Bender et al.
5,696,828	A	12/1997	Koopman, Jr.
5,719,937	A	2/1998	Warren et al.
5,721,788	A	2/1998	Powell et al.
5,734,752	A	3/1998	Knox
5,737,416	A	4/1998	Cooper et al.
5,737,733	A	4/1998	Eller
5,740,244	A	4/1998	Indeck et al.
5,745,569	A	4/1998	Moskowitz et al.
5,748,783	A	5/1998	Rhoads
5,751,811	A	5/1998	Magnotti et al.
5,754,697	A	5/1998	Fu et al.
5,757,923	A	5/1998	Koopman, Jr.
5,765,152	A	6/1998	Erickson
5,768,396	A	6/1998	Sone
5,774,452	A	6/1998	Wolosewicz
5,790,677	A	8/1998	Fox et al.
5,799,083	A	8/1998	Brothers et al.
5,809,139	A	9/1998	Girod et al.
5,809,160	A	9/1998	Powell et al.
5,828,325	A	10/1998	Wolose Wicz et al.
5,832,119	A	11/1998	Rhoads
5,848,155	A	12/1998	Cox
5,850,481	A	12/1998	Rhoads
5,859,920	A	1/1999	Daly et al.
5,860,099	A	1/1999	Milios et al.
5,862,260	A	1/1999	Rhoads
5,870,474	A	2/1999	Wasilewski et al.
5,884,033	A	3/1999	Duvall et al.
5,889,868	A	3/1999	Moskowitz et al.
5,893,067	A	4/1999	Bender et al.
5,894,521	A	4/1999	Conley
5,903,721	A	5/1999	Sixtus
5,905,800	A	5/1999	Moskowitz et al.
5,905,975	A	5/1999	Ausubel
5,912,972	A	6/1999	Barton
5,915,027	A	6/1999	Cox et al.
5,917,915	A	6/1999	Hirose
5,918,223	A	6/1999	Blum
5,920,900	A	7/1999	Poole et al.
5,923,763	A	7/1999	Walker et al.
5,930,369	A	7/1999	Cox et al.
5,930,377	A	7/1999	Powell et al.
5,940,134	A	8/1999	Wirtz
5,943,422	A	8/1999	Van Wie et al.
5,963,909	A	10/1999	Warren et al.
5,973,731	A	10/1999	Schwab
5,974,141	A	10/1999	Saito
5,991,426	A	11/1999	Cox et al.
5,999,217	A	12/1999	Berners-Lee
6,009,176	A	12/1999	Gennaro et al.
6,029,126	A	2/2000	Malvar
6,041,316	A	3/2000	Allen
6,049,838	A	4/2000	Miller et al.
6,051,029	A	4/2000	Paterson et al.
6,061,793	A	5/2000	Tewfik et al.
6,069,914	A	5/2000	Cox
6,078,664	A	6/2000	Moskowitz et al.
6,081,251	A	6/2000	Sakai et al.
6,081,597	A	6/2000	Hoffstein et al.
6,088,455	A *	7/2000	Logan et al. 380/200
6,131,162	A	10/2000	Yoshiura et al.
6,141,753	A	10/2000	Zhao et al.
6,141,754	A	10/2000	Choy
6,154,571	A	11/2000	Cox et al.
6,199,058	B1	3/2001	Wong et al.
6,205,249	B1	3/2001	Moskowitz
6,208,745	B1	3/2001	Florencio et al.
6,230,268	B1	5/2001	Miwa et al.
6,233,347	B1	5/2001	Chen et al.
6,233,684	B1	5/2001	Stefik et al.
6,240,121	B1	5/2001	Senoh
6,263,313	B1	7/2001	Milsted et al.
6,272,634	B1	8/2001	Tewfik et al.
6,275,988	B1	8/2001	Nagashima et al.
6,278,780	B1	8/2001	Shimada
6,278,791	B1	8/2001	Honsinger et al.
6,282,300	B1	8/2001	Bloom et al.
6,282,650	B1	8/2001	Davis
6,285,775	B1	9/2001	Wu et al.
6,301,663	B1	10/2001	Kato et al.
6,310,962	B1	10/2001	chung et al.
6,330,335	B1	12/2001	Rhoads
6,330,672	B1	12/2001	Shur
6,345,100	B1	2/2002	Levine
6,351,765	B1	2/2002	Pietropaolo et al.
6,363,483	B1	3/2002	Keshav
6,373,892	B1	4/2002	Ichien et al.
6,373,960	B1	4/2002	Conover et al.
6,377,625	B1	4/2002	Kim
6,381,618	B1	4/2002	Jones et al.
6,381,747	B1	4/2002	Wonfor et al.
6,385,329	B1	5/2002	Sharma et al.
6,389,538	B1	5/2002	Gruse et al.
6,405,203	B1	6/2002	Collart
6,415,041	B1	7/2002	Oami et al.
6,425,081	B1	7/2002	Iwamura
6,430,301	B1	8/2002	Petrovic
6,430,302	B2	8/2002	Rhoads
6,442,283	B1	8/2002	Tewfik et al.

6,453,252	B1	9/2002	Laroche
6,457,058	B1	9/2002	Ullum et al.
6,463,468	B1	10/2002	Buch et al.
6,493,457	B1	12/2002	Quackenbush
6,522,769	B1	2/2003	Rhoads et al.
6,523,113	B1	2/2003	Wehrenberg
6,530,021	B1	3/2003	Epstein et al.
6,532,284	B2	3/2003	Walker et al.
6,539,475	B1	3/2003	Cox et al.
6,557,103	B1	4/2003	Boncelet, Jr. et al.
6,584,125	B1	6/2003	Katto
6,587,837	B1	7/2003	Spagna et al.
6,598,162	B1	7/2003	Moskowitz
6,606,393	B1	8/2003	Xie et al.
6,647,424	B1	11/2003	Pearson et al.
6,658,010	B1	12/2003	Enns et al.
6,665,489	B2	12/2003	Collart
6,668,246	B1	12/2003	Yeung et al.
6,668,325	B1	12/2003	Collberg et al.
6,687,683	B1	2/2004	Harada et al.
6,725,372	B1	4/2004	Lewis et al.
6,754,822	B1	6/2004	Zhao
6,775,772	B1	8/2004	Binding et al.
6,784,354	B1	8/2004	Lu et al.
6,785,815	B1	8/2004	Serret-Avila et al.
6,823,455	B1	11/2004	Macy et al.
6,834,308	B1	12/2004	Ikezoye et al.
6,842,862	B2	1/2005	Chow et al.
6,931,534	B1	8/2005	Jandel et al.
6,966,002	B1	11/2005	Torrubia-Saez
6,983,337	B2	11/2005	Wold
6,977,894	B1	12/2005	Achilles et al.
6,978,370	B1	12/2005	Kocher
7,020,285	B1	3/2006	Kirovski et al.
7,043,050	B2	5/2006	Yuval
7,046,808	B1	5/2006	Metois et al.
7,050,396	B1	5/2006	Cohen et al.
7,051,208	B2	5/2006	Venkatesan et al.
7,058,570	B1	6/2006	Yu et al.
7,093,295	B1	8/2006	Saito
7,107,451	B2	9/2006	Moskowitz
7,150,003	B2	12/2006	Naumovich et al.
7,162,642	B2	1/2007	Schumann et al.
7,177,430	B2	2/2007	Kim
7,206,649	B2	4/2007	Kirovski et al.
7,231,524	B2	6/2007	Bums
7,240,210	B2	7/2007	Mihcak et al.
7,266,697	B2	9/2007	Kirovski et al.
7,286,451	B2	10/2007	Wirtz et al.
7,289,643	B2	10/2007	Brunk et al.
7,363,278	B2	4/2008	Schmelzer et al.
7,460,994	B2	12/2008	Herre et al.
2001/0043594	A1*	11/2001	Ogawa et al. 370/356
2002/0026343	A1	2/2002	Duenke
2002/0073043	A1	6/2002	Herman et al.
2002/0097873	A1	7/2002	Petrovic
2002/0103883	A1	8/2002	Haverstock et al.
2002/0161741	A1	10/2002	Wang et al.
2003/0126445	A1	7/2003	Wehrenberg
2003/0133702	A1	7/2003	Collart
2004/0028222	A1	2/2004	Sewell et al.
2004/0037449	A1	2/2004	Davis et al.
2004/0049695	A1	3/2004	Choi et al.
2004/0059918	A1	3/2004	Xu
2004/0083369	A1	4/2004	Erlingsson et al.
2004/0093521	A1	5/2004	Hamadeh et al.
2004/0125983	A1	7/2004	Reed et al.
2004/0128514	A1	7/2004	Rhoads
2005/0160271	A9	7/2005	Brundage et al.
2005/0246554	A1	11/2005	Batson
2006/0005029	A1	1/2006	Petrovic et al.
2006/0013395	A1	1/2006	Brundage et al.
2006/0013451	A1	1/2006	Haitsma
2006/0041753	A1	2/2006	Haitsma
2007/0083467	A1	4/2007	Lindahl et al.
2007/0127717	A1	6/2007	Herre et al.
2007/0253594	A1	11/2007	Lu et al.

FOREIGN PATENT DOCUMENTS

EP	0565947	A1	10/1993
EP	0581317	A2	2/1994
EP	0649261		4/1995
EP	0651554	A	5/1995
EP	1354276	B1	12/2007
NL	100523		9/1998
WO	WO 95/14289		5/1995
WO	96/29795		9/1996
WO	97/24833		7/1997
WO	WO 9744736		11/1997
WO	WO98/37513		8/1998
WO	WO 9952271		10/1999
WO	WO 99/62044		12/1999
WO	WO 9963443		12/1999

OTHER PUBLICATIONS

Caronni, Germano, "Assuring Ownership Rights for Digital Images", published proceeds of reliable IT systems, v15 '95, H.H. Bruggemann and W Gerhardt-Hackel (Ed.) Viewing Publishing Company Germany 1995.

Zhao, Jian. "A WWW Service to Embed and Prove Digital Copyright Watermarks", Proc. of the european conf. on Mulitmedia Applications, Services & Techinques Louvain-I a-Nevve Belgium, May 1996.

Gruhl,Daniel et al.,Echo Hiding. In Proceeding of the Workshop on Information Hiding. No. 1174 in Lecture Notes in Computer Science,Cambridge,England (May/Jun. 1996).

Oomen,A.W.J. et al., A Variable Bit Rate Buried Data Channel for Compact Disc, J.Audio Eng.Sc.,vol. 43,No. 1/2,pp. 23-28 (1995).

Ten Kate,W. et al., A New Surround-Stereo-Surround Coding Techniques, J. Audio Eng.Soc.,vol. 40,No. 5,pp. 376-383 (1992).

Gerzon, Michael et al., A High Rate Buried Data Channel for Audio CD, presentation notes, Audio Engineering Soc. 94th Convention (1993).

Sklar,Bernard, Digital Communications, pp. 601-603 (1988).

Jayant, N.S. et al., Digital Coding of Waveforms, Prentice Hall Inc., Englewood Cliffs,NJ, pp. 486-509 (1984).

Bender, Walter R. et al., Techniques for Data Hiding, SPIE Int. Soc. Opt. Eng., vol. 2420, pp. 164-173, 1995.

Zhao, Jian et al., Embedding Robust Labels into Images for Copyright Protection, (xp 000571976), pp. 242-251, 1995.

Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 175, 1997.

Schneier, Bruce, Applied Cryptography, 1st Ed., pp. 67-68, 1994.

ten Kate, W. et al., "Digital Audio Carrying Extra Information", IEEE, CH 2847-2/90/0000-1097, (1990).

van Schyndel, et al. A digital Watermark, IEEE Int'l Computer Processing Conference, Austin,TX, Nov. 13-16, 1994, pp. 86-90.

Smith, et al. Modulation and Information Hiding in Images, Springer Verlag, 1st Int'l Workshop, Cambridge, UK, May 30-Jun. 1, 1996, pp. 207-227.

Puate, Joan et al., Using Fractal Compression Scheme to Embed a Digital Signature into an Image, SPIE-96 Proceedings, vol. 2915, Mar. 1997, pp. 108-118.

Swanson, Mitchell D.,et al.; Transparent Robust Image Watermarking, Proc. of the 1996 IEEE Int'l Conf. on Image Processing, vol. 111, 1996, pp. 211-214.

Swanson, Mitchell D., et al. Robust Data Hiding for Images, 7th IEEE Digital Signal Processing Workshop, Leon, Norway. Sep. 1-4, 1996, pp. 37-40.

Koch, E., et al., Towards Robust and Hidden Image Copyright Labeling, 1995 IEEE Workshop on Nonlinear Signal and Image Processing, Jun. 1995 Neos Marmaras pp. 4.

Van Schyandel, et al., Towards a Robust Digital Watermark, Second Asain Image Processing Conference, Dec. 6-8, 1995,Singapore, vol. 2,pp. 504-508.

Tirkel,A.Z., A Two-Dimensional Digital Watermark, DICTA '95, Univ. of Queensland, Brisbane, Dec. 5-8, 1995, pp. 7.
Tirkel,A.Z., Image Watermarking—A Spread Spectrum Application, ISSSTA '96, Sep. 1996, Mainz, German, pp. 6.
O'Ruanaidh, et al. Watermarking Digital Images for Copyright Protection, IEEE Proceedings, vol. 143, No. 4, Aug. 1996, pp. 250-256.
Kahn, D., The Code Breakers, The MacMillan Company, 1969, pp. xIII, 81-83,513,515,522-526,863.
Dept. of Electrical Engineering, Del Ft University of Technology, Del ft The Netherlands,Cr.C. Langelaar et al.,Copy Protection for Mulitmedia Data based on Labeling Techniques, Jul. 1996, 9 pp.
Craver, et al., Can Invisible Watermarks Resolve Rightful Ownerships? IBM Research Report, RC 20509 (Jul. 25, 1996) 21 pp.
Press, et al., Numerical Recipes In C, Cambridge Univ. Press, 1988, pp. 398-417.
Pohlmann, Ken C., Principles of Digital Audio, 3rd Ed., 1995, pp. 32-37, 40-48,138,147-149,332,333,364, 499-501,508-509,564-571.
Pohlmann, Ken C., Principles of Digital Audio, 2nd Ed., 1991, pp. 1-9,19-25,30-33,41-48,54-57,86-107,375-387.
Schneier, Bruce, Applied Cryptography, John Wiley & Sons, inc. , New York, 1994, pp. 68,69,387-392,1-57,273-275,321-324.
Boney, et al., Digital Watermarks for Audio Signals, Proceedings of the International Conf. on Multimedia Computing and Systems, Jun. 17-23, 1996 Hiroshima. Japan. 0-8186-7436-9196. pp. 473-480.
Johnson, et al., Transform Permuted Watermarking for Copyright Protection of Digital Video, IEEE Globecom 1998, Nov. 8-12, 1998, New York, New York, vol. 2. 1998. pp. 684-689 (ISBN 0-7803-4985-7).
Rivest, et al. "Pay Word and Micromint: Two Simple Micropayment Schemes,"MIT Laboratory for Computer Science, Cambridge, MA, May 7, 1996, pp. 1-18.
Bender, et al., Techniques for Data Hiding, IBM Systems Journal, vol. 35, Nos. 3 & 4,1996,pp. 313-336.
Moskowitz, Bandwith as Currency, IEEE Multimedia, Jan.-Mar. 2003, pp. 14-21.
Moskowitz, Multimedia Security Technologies for Digital Rights Management, 2006, Academic Press, "Introduction-Digital Rights Management" pp. 3-22.
Moskowitz, "What is Acceptable Quality in the Application of Digital Watermarking: Trade-offs of Security, Robustness and Quality", IEEE Computer Society Proceedings of ITCC 2002, Apr. 10, 2002, pp. 80-84.
Lemma, et al. "Secure Watermark Embedding through Partial Encryption", International Workshop on Digital Watermarking ("IWDW" 2006), Springer Lecture Notes in Computer Science,2006, (to appear) 13.
Kocher, et al., "Self Protecting Digital Content", Technical Report from the CRI Content Security Research Initiative, Crytography Research, Inc. 2002-2003. 14 pages.
Sirbu, M. et al., "Net Bill: An Internet Commerce System Optimized for Network Delivered Services", Digest of Papers of the Computer Society Computer Conference (Spring), Mar. 5, 1995, pp. 20-25, vol. CONF40.
Schunter, M. et al., "A Status Report on the SEMPER framework for Secure Electronic Commerce", Computer Networks and ISDN Systems, Sep. 30, 1998. pp. 1501-1510 vol. 30 No. 16-18 NI North Holland.
Konrad, K. et al., "Trust and Elecronic Commerce—more than a techinal problem," Proceedings of the 18th IEEE Symposium on Reliable Distributed System Oct. 19-22, 1999, pp. 360-365 Lausanne.
Kini, a. et al., "Trust in Electronic Commerce: Definition and Theoretical Considerations", Proceedings of the 31st Hawaii Int'l Conf on System Sciences (Cat. No. 98TB100216) Jan. 6-9, 1998, pp. 51-61. Los.
Steinauer D. D., et al., "Trust and Traceability in Electronic Commerce", Standard View, Sep. 1997, pp. 118-124, vol. 5 No. 3, ACM, USA.
Hartung, et al. "Multimedia Watermarking Techniques", Proceedings of the IEEE, Special Issue, Identification & Protection of Multimedia Information, pp. 1079-1107, Jul. 1999, vol. 87 No. 7, IEEE.
Rivest,et al., PayWord and MicroMint: Two simple micropayment schemes, MIT Laboratory for Computer Science, Cambridge, MA 02139, Apr. 27, 2001, pp. 1-18.
Horowitz, et al., The Art of Electronics, 2nd Ed., 1989, pp. 7.
Delaigle, J.-F., et al. "Digital Watermarking," Proceedings of the SPIE, vol. 2659, Feb. 1, 1996, pp. 99-110 (Abstract).
Schneider, M., et al. "Robust Content Based Digital Signature for Image Authentication," Proceedings of the International Conference on Image Processing (IC. Lausanne). Sep. 16-19, 1996, pp. 227-230, IEEE ISBN.
Cox, I. J., et al. "Secure Spread Spectrum Watermarking for Multimedia," IEEE Transactions on Image Processing, vol. 6 No. 12, Dec. 1, 1997, pp. 1673-1686.
Wong, Ping Wah. "A Public Key Watermark for Image Verification and Authentication," IEEE International Conference on Image Processing, vol. 1, Oct. 4-7, 1998, pp. 455-459.
Fabien A.P. Petitcolas, Ross J. Anderson and Markkus G. Kuhn, "Attacks on Copyright Marking Systems," LNCS, vol. 1525, Apr. 14-17, 1998, pp. 218-238 ISBN 3-540-65386-4.
Ross Anderson, "Stretching the Limits of Steganography," LNCS, vol. 1174, May/Jun. 1996, 10 pages, ISBN: 3-540-61996-8.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Watermarking", pre-publication, Summer 1997 4 pages.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Image Watermarking", Submitted to Signal Processing, Aug. 21, 1997, 19 pages.
PCT International Search Report, completed Sep. 13, 1995; (PCT/US95/08159) (2 pages).
PCT International Search Report, completed Jun. 11, 1996; (PCT/US96/10257) (4 pages).
Supplementary European Search Report, Mar. 5, 2004; (EP 96 91 9405) (1 page).
PCT International Search Report, completed Apr. 4, 1997; (PCT/US97/00651) (1 page).
PCT International Search Report, completed May 6, 1997; (PCT/US97/00652) (3 pages).
PCT International Search Report, completed Oct. 23, 1997; (PCT/US97/11455) (1 page).
PCT International Search Report, completed Jul. 12, 1999; (PCT/US99/07262) (3 pages).
PCT International Search Report, completed Jun. 30, 2000; (PCT/US00/06522) (7 pages).
Supplementary European Search Report, completed Jun. 27, 2002; (EP 00 91 9398) (1 page).
PCT International Search Report, date of mailing Mar. 15, 2001; (PCT/US00/18411) (5 pages).
PCT International Search Report, completed Jul. 20, 2001; (PCT/US00/18411) (5 pages).
PCT International Search Report, completed Mar. 20, 2001; (PCT/US00/33126) (6 pages).
PCT International Search Report, completed Jan. 26, 2001; (PCT/US00/21189) (3 pages).
European Search Report, completed Oct. 15, 2007; (EP 07 11 2420) (9 pages).
Staind (The Singles 1996-2006), Warner Music—Atlantic, Pre-Release CD image, 2006, 1 page.
Arctic Monkeys (Whatever People Say I Am, That's What I'm Not), Domino Recording Co. Ltd., Pre-Release CD image, 2005, 1 page.
Radiohead ("Hail To The Thief"), EMI Music Group—Capitol; Pre-Release CD image, 2003, 1 page.

* cited by examiner

METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 09/657,181, filed Sep. 7, 2000, entitled, "Method and Device for Monitoring and Analyzing Signals."

This application claims the benefit of pending U.S. patent application Ser. No. 08/999,766, filed Jul. 23, 1997, entitled "Steganographic Method and Device"; pending U.S. patent application Ser. No. 08/772,222, filed Dec. 20, 1996, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,078,664); pending U.S. patent application Ser. No. 09/456,319, filed Dec. 8, 1999, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,853,726); pending U.S. patent application. Ser. No. 08/674,726, filed Jul. 2, 1996, entitled "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management"; pending U.S. patent application Ser. No. 09/545,589, filed Apr. 7, 2000, entitled "Method and System for Digital. Watermarking" (issued as U.S. Pat. No. 7,007,166); pending U.S. patent application Ser. No. 09/046,627, filed Mar. 24, 1998, entitled "Method for Combining Transfer Function with Predetermined Key Creation" (issued as U.S. Pat. No. 6,598,162); pending U.S. patent application Ser. No. 09/053,628, filed Apr. 2, 1998, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking" (issued as U.S. Pat. No. 6,205,249); pending U.S. patent application Ser. No. 09/281,279, filed Mar. 30, 1999, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data (issued as U.S. Pat. No. 6,522,767)"; U.S. patent application Ser. No. 09,594,719, filed Jun. 16, 2000, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems" (which is a continuation-in-part of PCT application No. PCT/US00/06522, filed Mar. 14, 2000, which PCT application claimed priority to U.S. Provisional Application No. 60/125,990, filed Mar. 24, 1999) (issued as U.S. Pat. No. 7,123,718); pending U.S. Application No. 60/169, 274, filed Dec. 7, 1999, entitled "Systems, Methods And Devices For Trusted Transactions" (issued as U.S. Pat. No. 7,159,116); and PCT Application No. PCT/US00/21189, filed Aug. 4, 2000 (which claims priority to U.S. Patent Application Ser. No. 60/147,134, filed Aug. 4, 1999, and to U.S. Patent Application No. 60/213,489, filed. Jun. 23, 2000, both of which are entitled, "A Secure Personal Content Server"). The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties, as if fully stated herein.

In addition, this application hereby incorporates by reference, as if fully stated herein, the total disclosures of U.S. Pat. No. 5,613,004 "Steganographic Method and Device"; U.S. Pat. No. 5,745,569 "Method for Stega-Cipher Protection of Computer Code"; and U.S. Pat. No. 5,889,868 "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data."

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to the monitoring and analysis of digital information. A method and device are described which relate to signal recognition to enhance identification and monitoring activities.

2. Description of the Related Art

Many methods and protocols are known for transmitting data in digital form for multimedia applications (including computer applications delivered over public networks such as the internet or World Wide Web ("WWW"). These methods may include protocols for the compression of data, such that it may more readily and quickly be delivered over limited bandwidth data lines. Among standard protocols for data compression of digital files may be mentioned the MPEG compression standards for audio and video digital compression, promulgated by the Moving Picture Experts Group. Numerous standard reference works and patents discuss such compression and transmission standards for digitized information.

Digital watermarks help to authenticate the content of digitized multimedia information, and can also discourage piracy. Because piracy is clearly a disincentive to the digital distribution of copyrighted content, establishment of responsibility for copies and derivative copies of such works is invaluable. In considering the various forms of multimedia content, whether "master," stereo, NTSC video, audio tape or compact disc, tolerance of quality will vary with individuals and affect the underlying commercial and aesthetic value of the content. It is desirable to tie copyrights, ownership rights, purchaser information or some combination of these and related data into the content in such a manner that the content must undergo damage, and therefore reduction of its value, with subsequent, unauthorized distribution, commercial or otherwise. Digital watermarks address many of these concerns. A general discussion of digital watermarking as it has been applied in the art may be found in U.S. Pat. No. 5,687,236 (whose specification is incorporated in whole herein by reference).

Further applications of basic digital watermarking functionality have also been developed. Examples of such applications are shown in U.S. Pat. No. 5,889,868 (whose specification is incorporated in whole herein by reference). Such applications have been drawn, for instance, to implementations of digital watermarks that were deemed most suited to particular transmissions, or particular distribution and storage mediums, given the nature of digitally sampled audio, video, and other multimedia works. There have also been developed techniques for adapting watermark application parameters to the individual characteristics of a given digital sample stream, and for implementation of digital watermarks that are feature-based-i.e., a system in which watermark information is not carried in individual samples, but is carried in the relationships between multiple samples, such as in a waveform shape. For instance, natural extensions may be added to digital watermarks that may also separate frequencies (color or audio), channels in 3D while utilizing discreteness in feature-based encoding only known to those with pseudo-random keys (i.e., cryptographic keys) or possibly tools to access such information, which may one day exist on a quantum level.

A matter of general weakness in digital watermark technology relates directly to the manner of implementation of the watermark. Many approaches to digital watermarking leave detection and decode control with the implementing party of the digital watermark, not the creator of the work to be protected. This weakness removes proper economic incentives for improvement of the technology. One specific form of exploitation mostly regards efforts to obscure subsequent watermark detection. Others regard successful over encoding using the same watermarking process at a subsequent time. Yet another way to perform secure digital watermark implementation is through "key-based" approaches.

SUMMARY OF THE INVENTION

A method for monitoring and analyzing at least one signal is disclosed, which method comprises the steps of: receiving at least one reference signal to be monitored; creating an abstract of the at least one reference signal; storing the abstract of the at least one reference signal in a reference database; receiving at least one query signal to be analyzed; creating an abstract of the at least one query signal; and comparing the abstract of the at least one query signal to the abstract of the at least one reference signal to determine if the abstract of the at least one query signal matches the abstract of the at least one reference signal.

A method for monitoring a plurality of reference signals is also disclosed, which method comprises the steps of: creating an abstract for each one of a plurality of reference signals; storing each of the abstracts in a reference database; receiving at least one query signal to be analyzed; creating an abstract of each at least one query signal; locating an abstract in the reference database that matches the abstract of each at least one query signal; and recording the identify of the reference signal whose abstract matched the abstract of each at least one query signal.

A computerized system for monitoring and analyzing at least one signal is also disclosed, which system comprises: a processor for creating an abstract of a signal using selectable criteria; a first input for receiving at least one reference signal to be monitored, the first input being coupled to the processor such that the processor may generate an abstract for each reference signal input to the processor; a reference database, coupled to the processor, for storing abstracts of each at least one reference signal; a second input for receiving at least one query signal to be analyzed, the second input being coupled to the processor such that the processor may generate an abstract for each query signal; and a comparing device, coupled to the reference database and to the second input, for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

Further, an electronic system for monitoring and analyzing at least one signal is disclosed which system comprises: a first input for receiving at least one reference signal to be monitored, a first processor for creating an abstract of each reference signal input to the first processor through the first input; a second input for receiving at least one query signal to be analyzed, a second processor for creating an abstract of each query signal; a reference database for storing abstracts of each at least one reference signal; and a comparing device for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

DETAILED DESCRIPTION OF THE INVENTION

While there are many approaches to data reduction that can be utilized, a primary concern is the ability to reduce the digital signal in such a manner as to retain a "perceptual relationship" between the original signal and its data reduced version. This relationship may either be mathematically discernible or a result of market-dictated needs. The purpose is to afford a more consistent means for classifying signals than proprietary, related text-based approaches. A simple analogy is the way in which a forensic investigator uses a sketch artist to assist in determining the identity of a human.

In one embodiment of the invention, the abstract of a signal may be generated by the following steps: 1) analyze the

characteristics of each signal in a group of audible/perceptible variations for the same signal (e.g., analyze each of five versions of the same song-which versions may have the same lyrics and music but which are sung by different artists); and 2) select those characteristics which achieve or remain relatively constant (or in other words, which have minimum variation) for each of the signals in the group. Optionally, the null case may be defined using those characteristics which are common to each member of the group of versions.

Lossless and lossy compression schemes are appropriate candidates for data reduction technologies, as are those subset of approaches that are based on perceptual models, such as AAC, MP3, TwinVQ, JPEG, GIF, MPEG, etc. Where spectral transforms fail to assist in greater data reduction of the signal, other signal characteristics can be identified as candidates for further data reduction. Linear predictive coding (LPC), z-transform analysis, root mean square (rms), signal to peak, may be appropriate tools to measure signal characteristics, but other approaches or combinations of signal characteristic analysis are contemplated. While such signal characteristics may assist in determining particular applications of the present invention, a generalized approach to signal recognition is necessary to optimize the deployment and use of the present invention.

Increasingly, valuable information is being created and stored in digital form. For example, music, photographs and motion pictures can all be stored and transmitted as a series of binary digits—1's and 0's. Digital techniques permit the original information to be duplicated repeatedly with perfect or near perfect accuracy, and each copy is perceived by viewers or listeners as indistinguishable from the original signal. Unfortunately, digital techniques also permit the information to be easily copied without the owner's permission. While digital representations of analog waveforms may be analyzed by perceptually-based or perceptually-limited analysis it is usually costly and time-consuming to model the processes of the highly effective ability of humans to identify and recognize a signal. In those applications where analog signals require analysis, the cost of digitizing the analog signal is minimal when compared to the benefits of increased accuracy and speed of signal analysis and monitoring when the processes contemplated by this invention are utilized.

The present invention relates to identification of digitally-sampled information, such as images, audio and video. Traditional methods of identification and monitoring of those signals do not rely on "perceptual quality," but rather upon a separate and additional signal. Within this application, such signals will be called "additive signals" as they provide information about the original images, audio or video, but such information is in addition to the original signal. One traditional, text-based additive signal is title and author information. The title and author, for example, is information about a book, but it is in addition to the text of the book. If a book is being duplicated digitally, the title and author could provide one means of monitoring the number of times the text is being duplicated, for example, through an Internet download. The present invention, however, is directed to the identification of a digital signal—whether text, audio, or video—using only the digital signal itself and then monitoring the number of times the signal is duplicated. Reliance on an additive signal has many shortcomings. For example, first, someone must incorporate the additive signal within the digital data being transmitted, for example, by concatenation or through an embedding process. Such an additive signal, however, can be easily identified and removed by one who wants to utilize the original signal without paying for its usage. If the original signal itself is used to identify the content, an unauthorized

user could not avoid payment of a royalty simply by removing the additive signal—because there is no additive signal to remove. Hence, the present invention avoids a major disadvantage of the prior art.

One such additive signal that may be utilized is a digital watermark—which ideally cannot be removed without perceptually altering the original signal.A watermark may also be used as a monitoring signal (for example, by encoding an identifier that uniquely identifies the original digital signal into which the identifier is being embedded). A digital watermark used for monitoring is also an additive signal, and such a signal may make it difficult for the user who wants to duplicate a signal without paying a royalty—mainly by degrading the perceptual quality of the original signal if the watermark (and hence the additive monitoring signal) is removed. This is, however, is a different solution to the problem.

The present invention eliminates the need of any additive monitoring signal because the present invention utilizes the underlying content signal as the identifier itself. Nevertheless, the watermark may increase the value of monitoring techniques by increasing the integrity of the embedded data and by indicating tampering of either the original content signal or the monitoring signal. Moreover, the design of a watermarking embedding algorithm is closely related to the perceptibility of noise in any given signal and can represent an ideal subset of the original signal: the watermark bits are an inverse of the signal to the extent that lossy compression schemes, which can be used, for instance, to optimize a watermarking embedding scheme, can yield information about the extent to which a data signal can be compressed while holding steadfast to the design requirement that the compressed signal maintain its perceptual relationship with the original, uncompressed signal. By describing those bits that are candidates for imperceptible embedding of watermark bits, further data reduction may be applied on the candidate watermarks as an example of retaining a logical and perceptible relationship with the original uncompressed signal.

Of course, the present invention may be used in conjunction with watermarking technology (including the use of keys to accomplish secure digital watermarking), but watermarking is not necessary to practice the present invention. Keys for watermarking may have many forms, including: descriptions of the original carrier file formatting, mapping of embedded data (actually imperceptible changes made to the carrier signal and referenced to the predetermined key or key pairs), assisting in establishing the watermark message data integrity (by incorporation of special one way functions in the watermark message data or key), etc. Discussions of these systems in the patents and pending patent applications are incorporated by reference above. The "recognition" of a particular signal or an instance of its transmission, and its monitoring are operations that may be optimized through the use of digital watermark analysis.

A practical difference between the two approaches of using a separate, additive monitoring signal and using the original signal itself as the monitoring signal is control. If a separate signal is used for monitoring, then the originator of the text, audio or video signal being transmitted and the entity doing the monitoring have to agree as to the nature of the separate signal to be used for monitoring—otherwise, the entity doing the monitoring would not know where to look, for what to look, or how to interpret the monitoring signal once it was identified and detected. On the other hand, if the original signal is used itself as a monitoring signal, then no such agreement is necessary. Moreover, a more logical and self-sufficient relationship between the original and its data-re-

duced abstract enhances the transparency of any resulting monitoring efforts. The entity doing the monitoring is not looking for a separate, additive monitoring system, and further, need not have to interpret the content of the monitoring signal.

Monitoring implementations can be handled by robust watermark techniques (those techniques that are able to survive many signal manipulations but are not inherently "secure" for verification of a carrier signal absent a logically-related watermarking key) and forensic watermark techniques (which enable embedding of watermarks that are not able to survive perceptible alteration of the carrier signal and thus enable detection of tampering with the originally watermarked carrier signal). The techniques have obvious trade-offs between speed, performance and security of the embedded watermark data.

In other disclosures, we suggest improvements and implementations that relate to digital watermarks in particular and embedded signaling in general. A digital watermark may be used to "tag" content in a manner that is not humanly-perceptible, in order to ensure that the human perception of the signal quality is maintained. Watermarking, however, must inherently alter at least one data bit of the original signal to represent a minimal change from the original signal's "unwatermarked state." The changes may affect only a bit, at the very least, or be dependent on information hiding relating to signal characteristics, such as phase information, differences between digitized samples, root mean square (RMS) calculations, z-transform analysis, or similar signal characteristic category.

There are weaknesses in using digital watermark technology for monitoring purposes. One weakness relates directly to the way in which watermarks are implemented. Often, the persons responsible for encoding and decoding the digital watermark are not the creator of the valuable work to be protected. As such, the creator has no input on the placement of the monitoring signal within the valuable work being protected. Hence, if a user wishing to avoid payment of the royalty can find a way to decode or remove the watermark, or at least the monitoring signal embedded in the watermark, then the unauthorized user may successfully duplicate the signal with impunity. This could occur, for example, if either of the persons responsible for encoding or decoding were to have their security compromised such that the encoding or decoding algorithms were discovered by the unauthorized user.

With the present invention, no such disadvantages exist because the creator need not rely on anyone to insert a monitoring signal—as no such signal is necessary. Instead, the creator's work itself is used as the monitoring signal. Accordingly, the value in the signal will have a strong relationship with its recognizability.

By way of improving methods for efficient monitoring as well as effective confirmation of the identity of a digitally-sampled signal, the present invention describes useful methods for using digital signal processing for benchmarking a novel basis for differencing signals with binary data comparisons. These techniques may be complemented with perceptual techniques, but are intended to leverage the generally decreasing cost of bandwidth and signal processing power in an age of increasing availability and exchange of digitized binary data.

So long as there exist computationally inexpensive ways of identifying an entire signal with some fractional representation or relationship with the original signal, or its perceptually observable representation, we envision methods for faster and more accurate auditing of signals as they are played, distrib-

uted or otherwise shared amongst providers (transmitters) and consumers (receivers). The ability to massively compress a signal to its essence—which is not strictly equivalent to "lossy" or "lossless" compression schemes or perceptual coding techniques, but designed to preserve some underlying "aesthetic quality" of the signal—represents a useful means for signal analysis in a wide variety of applications. The signal analysis, however, must maintain the ability to distinguish the perceptual quality of the signals being compared. For example, a method which analyzed a portion of a song by compressing it to a single line of lyrics fails to maintain the ability to distinguish the perceptual quality of the songs being compared. Specifically, for example, if the song "New York State of Mind" were compressed to the lyrics "I'm in a New York State of Mind," such a compression fails to maintain the ability to distinguish between the various recorded versions of the song, say, for example between Billy Joel's recording and Barbara Streisand's recording. Such a method is, therefore, incapable of providing accurate monitoring of the artist's recordings because it could not determine which of the two artists is deserving of a royalty—unless of course, there is a separate monitoring signal to provide the name of the artist or other information sufficient to distinguish the two versions. The present invention, however, aims to maintain some level of perceptual quality of the signals being compared and would deem such a compression to be excessive.

This analogy can be made clearer if it is understood that there are a large number of approaches to compressing a signal to, say, $1/10{,}000^{th}$ of its original size, not for maintaining its signal quality to ensure computational ease for commercial quality distribution, but to assist in identification, analysis or monitoring of the signal. Most compression is either lossy or lossless and is designed with psychoacoustic or psychovisual parameters. That is to say, the signal is compressed to retain what is "humanly-perceptible." As long as the compression successfully mimics human perception, data space may be saved when the compressed file is compared to the uncompressed or original file. While psychoacoustic and psychovisual compression has some relevance to the present invention, additional data reduction or massive compression is anticipated by the present invention. It is anticipated that the original signal may be compressed to create a realistic or self-similar representation of the original signal, so that the compressed signal can be referenced at a subsequent time as unique binary data that has computational relevance to the original signal. Depending on the application, general data reduction of the original signal can be as simple as massive compression or may relate to the watermark encoding envelope parameter (those bits which a watermarking encoding algorithm deem as candidate bits for mapping independent data or those bits deemed imperceptible to human senses but detectable to a watermark detection algorithm). In this manner, certain media which are commonly known by signal characteristics, a painting, a song, a TV commercial, a dialect, etc., may be analyzed more accurately, and perhaps, more efficiently than a text-based descriptor of the signal. So long as the sender and receiver agree that the data representation is accurate, even insofar as the data-reduction technique has logical relationships with the perceptibility of the original signal, as they must with commonly agreed to text descriptors, no independent cataloging is necessary.

The present invention generally contemplates a signal recognition system that has at least five elements. The actual number of elements may vary depending on the number of domains in which a signal resides (for example, audio is at least one domain while visual carriers are at least two dimensional). The present invention contemplates that the number of elements will be sufficient to effectively and efficiently meet the demands of various classes of signal recognition. The design of the signal recognition that may be used with data reduction is better understood in the context of the general requirements of a pattern or signal recognition system.

The first element is the reference database, which contains information about a plurality of potential signals that will be monitored. In one form, the reference database would contain digital copies of original works of art as they are recorded by the various artists, for example, contain digital copies of all songs that will be played by a particular radio station. In another form, the reference database would contain not perfect digital copies of original works of art, but digital copies of abstracted works of art, for example, contain digital copies of all songs that have been preprocessed such that the copies represent the perceptual characteristics of the original songs. In another form, the reference database would contain digital copies of processed data files, which files represent works of art that have been preprocessed in such a fashion as to identify those perceptual differences that can differentiate one version of a work of art from another version of the same work of art, such as two or more versions of the same song, but by different artists. These examples have obvious application to visually communicated works such as images, trademarks or photographs, and video as well.

The second element is the object locator, which is able to segment a portion of a signal being monitored for analysis (i.e., the "monitored signal"). The segmented portion is also referred to as an "object." As such, the signal being monitored may be thought of comprising a set of objects. A song recording, for example, can be thought of as having a multitude of objects. The objects need not be of uniform length, size, or content, but merely be a sample of the signal being monitored. Visually communicated informational signals have related objects; color and size are examples.

The third element is the feature selector, which is able to analyze a selected object and identify perceptual features of the object that can be used to uniquely describe the selected object. Ideally, the feature selector can identify all, or nearly all, of the perceptual qualities of the object that differentiate it from a similarly selected object of other signals. Simply, a feature selector has a direct relationship with the perceptibility of features commonly observed. Counterfeiting is an activity which specifically seeks out features to misrepresent the authenticity of any given object. Highly granular, and arguably successful, counterfeiting is typically sought for objects that are easily recognizable and valuable, for example, currency, stamps, and trademarked or copyrighted works and objects that have value to a body politic.

The fourth element is the comparing device which is able to compare the selected object using the features selected by the feature selector to the plurality of signals in the reference database to identify which of the signals matches the monitored signal. Depending upon how the information of the plurality of signals is stored in the reference database and depending upon the available computational capacity (e.g., speed and efficiency), the exact nature of the comparison will vary. For example, the comparing device may compare the selected object directly to the signal information stored in the database. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector and then compare the selected object to the processed signal information. Alternatively, the comparing device may need to process the selected object using input from the feature selector and then compare the processed selected object to the signal information. Alternatively, the comparing device may need to process the signal

information stored in the database using input from the feature selector, process the selected object using input from the feature selector, and then compare the processed selected object to the processed signal information.

The fifth element is the recorder which records information about the number of times a given signal is analyzed and detected. The recorder may comprise a database which keeps track of the number of times a song, image, or a movie has been played, or may generate a serial output which can be subsequently processed to determine the total number of times various signals have been detected.

Other elements may be added to the system or incorporated into the five elements identified above. For example, an error handler may be incorporated into the comparing device. If the comparing device identifies multiple signals which appear to contain the object being sought for analysis or monitoring, the error handler may offer further processing in order to identify additional qualities or features in the selected object such that only one of the set of captured signals is found to contain the further analyzed selected object that actually conforms with the object thought to have been transmitted or distributed.

Moreover, one or more of the five identified elements may be implemented with software that runs on the same processor, or which uses multiple processors. In addition, the elements may incorporate dynamic approaches that utilize stochastic, heuristic, or experience-based adjustments to refine the signal analysis being conducted within the system, including, for example, the signal analyses being performed within the feature selector and the comparing device. This additional analyses may be viewed as filters that are designed to meet the expectations of accuracy or speed for any intended application.

Since maintenance of original signal quality is not required by the present invention, increased efficiencies in processing and identification of signals can be achieved. The present invention concerns itself with perceptible relationships only to the extent that efficiencies can be achieved both in accuracy and speed with enabling logical relationships between an original signal and its abstract.

The challenge is to maximize the ability to sufficiently compress a signal to both retain its relationship with the original signal while reducing the data overhead to enable more efficient analysis, archiving and monitoring of these signals. In some cases, data reduction alone will not suffice: the sender and receiver must agree to the accuracy of the recognition. In other cases, agreement will actually depend on a third party who authored or created the signal in question. A digitized signal may have parameters to assist in establishing more accurate identification, for example, a "signal abstract" which naturally, or by agreement with the creator, the copyright owner or other interested parties, can be used to describe the original signal. By utilizing less than the original signal, a computationally inexpensive means of identification can be used. As long as a realistic set of conditions can be arrived at governing the relationship between a signal and its data reduced abstract, increases in effective monitoring and transparency of information data flow across communications channels is likely to result. This feature is significant in that it represents an improvement over how a digitally-sampled signal can be cataloged and identified, though the use of a means that is specifically selected based upon the strengths of a general computing device and the economic needs of a particular market for the digitized information data being monitored. The additional benefit is a more open means to uniformly catalog, analyze, and monitor signals. As well, such benefits can exist for third parties, who have a significant interest in the signal but are not the sender or receiver of said information.

As a general improvement over the art, the present invention incorporates what could best be described as "computer-acoustic" and "computer-visual" modeling, where the signal abstracts are created using data reduction techniques to determine the smallest amount of data, at least a single bit, which can represent and differentiate two digitized signal representations for a given predefined signal set. Each of such representations must have at least a one bit difference with all other members of the database to differentiate each such representation from the others in the database. The predefined signal set is the object being analyzed. The signal identifier/detector should receive its parameters from a database engine. The engine will identify those characteristics (for example, the differences) that can be used to distinguish one digital signal from all other digital signals that are stored in its collection. For those digital signals or objects which are seemingly identical, except that the signal may have different performance or utilization in the newly created object, benefits over additive or text-based identifiers are achieved. Additionally, decisions regarding the success or failure of an accurate detection of any given object may be flexibly implemented or changed to reflect market-based demands of the engine. Appropriate examples are songs or works or art which have been sampled or re-produced by others who are not the original creator.

In some cases, the engine will also consider the NULL case for a generalized item not in its database, or perhaps in situations where data objects may have collisions. For some applications, the NULL case is not necessary, thus making the whole system faster. For instance, databases which have fewer repetitions of objects or those systems which are intended to recognize signals with time constraints or capture all data objects. Greater efficiency in processing a relational database can be obtained because the rules for comparison are selected for the maximum efficiency of the processing hardware and/or software, whether or not the processing is based on psychoacoustic or psychovisual models. The benefits of massive data reduction, flexibility in constructing appropriate signal recognition protocols and incorporation of cryptographic techniques to further add accuracy and confidence in the system are clearly improvements over the art. For example, where the data reduced abstract needs to have further uniqueness, a hash or signature may be required. And for objects which have further uniqueness requirements, two identical instances of the object could be made unique with cryptographic techniques.

Accuracy in processing and identification may be increased by using one or more of the following fidelity evaluation functions:

1) RMS (root mean square). For example, a RMS function may be used to assist in determining the distance between data based on mathematically determinable Euclidean distance between the beginning and end data points (bits) of a particular signal carrier.

2) Frequency weighted RMS. For example, different weights may be applied to different frequency components of the carrier signal before using RMS. This selective weighting can assist in further distinguishing the distance between beginning and end points of the signal carrier (at a given point in time, described as bandwidth, or the number of total bits that can be transmitted per second) and may be considered to be the mathematical equivalent of passing a carrier signal difference through a data filter and figuring the average power in the output carrier.

3) Absolute error criteria, including particularly the NULL set (described above) The NULL may be utilized in two significant cases: First, in instances where the recognized signal appears to be an identified object which is inaccurately attributed or identified to an object not handled by the database of objects; and second, where a collision of data occurs. For instance, if an artist releases a second performance of a previously recorded song, and the two performances are so similar that their differences are almost imperceptible, then the previously selected criteria may not be able to differentiate the two recordings. Hence, the database must be "recalibrated" to be able to differentiate these two versions. Similarly, if the system identifies not one, but two or more, matches for a particular search, then the database may need "recalibration" to further differentiate the two objects stored in the database.

4) Cognitive Identification. For example, the present invention may use an experience-based analysis within a recognition engine. Once such analysis may involve mathematically determining a spectral transform or its equivalent of the carrier signal. A spectral transform enables signal processing and should maintain, for certain applications, some cognitive or perceptual relationship with the original analog waveform. As a novel feature to the present invention, additional classes may be subject to humanly-perceptible observation. For instance, an experience-based criteria which relates particularly to the envisioned or perceived accuracy of the data information object as it is used or applied in a particular market, product, or implementation. This may include a short 3 second segment of a commercially available and recognizable song which is used for commercials to enable recognition of the good or service being marketed. The complete song is marketed as a separately valued object from the use of a discrete segment of the song (that may be used for promotion or marketing-for the complete song or for an entirely different good or service). To the extent that an owner of the song in question is able to further enable value through the licensing or agreement for use of a segment of the original signal, cognitive identification is a form of filtering to enable differentiations between different and intended uses of the same or subset of the same signal (object). The implementation relating specifically, as disclosed herein, to the predetermined identification or recognition means and/or any specified relationship with subsequent use of the identification means can be used to create a history as to how often a particular signal is misidentified, which history can then be used to optimize identification of that signal in the future. The difference between use of an excerpt of the song to promote a separate and distinct good or service and use of the excerpt to promote recognition of the song itself (for example, by the artist to sell copies of the song) relates informationally to a decision based on recognized and approved use of the song. Both the song and applications of the song in its entirety or as a subset are typically based on agreement by the creator and the sender who seeks to utilize the work. Trust in the means for identification, which can be weighted in the present invention (for example, by adjusting bit-addressable information), is an important factor in adjusting the monitoring or recognition features of the object or carrier signal, and by using any misidentification information, (including any experience-based or heuristic information), additional features of the monitored signal can be used to improve the performance of the monitoring system envisioned herein. The issue of central concern with cognitive identification is a greater understanding of the parameters by which any given object is to be analyzed. To the extent that a creator chooses varying and separate application of his object, those applications having a cognitive difference in a signal recognition sense (e.g., the whole or an excerpt), the system contemplated herein includes rules for governing the application of bit-addressable information to increase the accuracy of the database.

5) Finally, the predetermined parameters that are associated with a discrete case for any given object will have a significant impact upon the ability to accurately process and identify the signals. For example, if a song is transmitted over a FM carrier, then one skilled in the art will appreciate that the FM signal has a predetermined bandwidth which is different from the bandwidth of the original recording, and different even from song when played on an AM carrier, and different yet from a song played using an 8-bit Internet broadcast. Recognition of these differences, however, will permit the selection of an identification means which can be optimized for monitoring a FM broadcasted signal. In other words, the discreteness intended by the sender is limited and directed by the fidelity of the transmission means. Objects may be cataloged and assessing with the understanding that all monitoring will occur using a specific transmission fidelity. For example, a database may be optimized with the understanding that only AM broadcast signals will be monitored. For maximum efficiency, different data bases may be created for different transmission channels, e.g., AM broadcasts, FM broadcasts, Internet broadcasts, etc.

For more information on increasing efficiencies for information systems, see *The Mathematical Theory of Communication* (1948), by Shannon.

Because bandwidth (which in the digital domain is equated to the total number of bits that can be transmitted in a fixed period of time) is a limited resource which places limitations upon transmission capacity and information coding schemes, the importance of monitoring for information objects transmitted over any given channel must take into consideration the nature and utilization of a given channel. The supply and demand of bandwidth will have a dramatic impact on the transmission, and ultimately, upon the decision to monitor and recognize signals. A discussion of this is found in a co-pending application by the inventor under U.S. patent application Ser. No. 08/674,726 "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (which application is incorporated herein by reference as if fully setforth herein).

If a filter is to be used in connection with the recognition or monitoring engine, it may be desirable for the filter to anticipate and take into consideration the following factors, which affect the economics of the transmission as they relate to triggers for payment and/or relate to events requiring audits of the objects which are being transmitted: 1) time of transmission (i.e., the point in time when the transmission occurred), including whether the transmission is of a live performance); 2) location of transmission (e.g., what channel was used for transmission, which usually determines the associated cost for usage of the transmission channel); 3) the point of origination of the transmission (which may be the same for a signal carrier over many distinct channels); and 4) pre-existence of the information carrier signal (pre-recorded or newly created information carrier signal, which may require differentiation in certain markets or instances).

In the case of predetermined carrier signals (those which have been recorded and stored for subsequent use), "positional information carrier signals" are contemplated by this invention, namely, perceptual differences between the seemingly "same" information carrier that can be recognized as consumers of information seek different versions or quality levels of the same carrier signal. Perceptual differences exist

between a song and its reproduction from a CD, an AM radio, and an Internet broadcast. To the extent that the creator or consumer of the signal can define a difference in any of the four criteria above, means can be derived (and programmed for selectability) to recognize and distinguish these differences. It is, however, quite possible that the ability to monitor carrier signal transmission with these factors will increase the variety and richness of available carrier signals to existing communications channels. The differentiation between an absolute case for transmission of an object, which is a time dependent event, for instance a live or real time broadcast, versus the relative case, which is prerecorded or stored for transmission at a later point in time, creates recognizable differences for signal monitoring.

The monitoring and analysis contemplated by this invention may have a variety of purposes, including, for example, the following: to determine the number of times a song is broadcast on a particular radio broadcast or Internet site; to control security though a voice-activated security system; and to identify associations between a beginner's drawing and those of great artists (for example to draw comparisons between technique, compositions, or color schemes). None of these examples could be achieved with any significant degree of accuracy using a text-based analysis. Additionally, strictly text-based systems fail to fully capture the inherent value of the data recognition or monitoring information itself.

SAMPLE EMBODIMENTS

Sample Embodiment 1

A database of audio signals (e.g., songs) is stored or maintained by a radio station or Internet streaming company, who may select a subset of the songs are stored so that the subset may be later broadcast to listeners. The subset, for example, may comprise a sufficient number of songs to fill 24 hours of music programming (between 300 or 500 songs). Traditionally, monitoring is accomplished by embedding some identifier into the signal, or affixing the identifier to the signal, for later analysis and determination of royalty payments. Most of the traditional analysis is performed by actual persons who use play lists and other statistical approximations of audio play, including for example, data obtained through the manual (i.e., by persons) monitoring of a statistically significant sample of stations and transmission times so that an extrapolation may be made to a larger number of comparable markets.

The present invention creates a second database from the first database, wherein each of the stored audio signals in the first database is data reduced in a manner that is not likely to reflect the human perceptual quality of the signal, meaning that a significantly data-reduced signal is not likely to be played back and recognized as the original signal. As a result of the data reduction, the size of the second database (as measured in digital terms) is much smaller than the size of the first database, and is determined by the rate of compression. If, for example, if 24 hours worth of audio signals are compressed at a 10,000:1 compression rate, the reduced data could occupy a little more than 1 megabyte of data. With such a large compression rate, the data to be compared and/or analyzed may become computationally small such that computational speed and efficiency are significantly improved.

With greater compression rates, it is anticipated that similarity may exist between the data compressed abstractions of different analog signals (e.g., recordings by two different artists of the same song). The present invention contemplates the use of bit-addressable differences to distinguish between

such cases. In applications where the data to be analyzed has higher value in some predetermined sense, cryptographic protocols, such as a hash or digital signature, can be used to distinguish such close cases.

In a preferred embodiment, the present invention may utilize a centralized database where copies of new recordings may be deposited to ensure that copyright owners, who authorize transmission or use of their recordings by others, can independently verify that the object is correctly monitored. The rules for the creator himself to enter his work would differ from a universally recognized number assigned by an independent authority (say, ISRC, ISBN for recordings and books respectively). Those skilled in the art of algorithmic information theory (AIT) can recognize that it is now possible to describe optimized use of binary data for content and functionality. The differences between objects must relate to decisions made by the user of the data, introducing subjective or cognitive decisions to the design of the contemplated invention as described above. To the extent that objects can have an optimized data size when compared with other objects for any given set of objects, the algorithms for data reduction would have predetermined flexibility directly related to computational efficiency and the set of objects to be monitored. The flexibility in having transparent determination of unique signal abstracts, as opposed to independent third party assignment, is likely to increase confidence in the monitoring effort by the owners of the original signals themselves. The prior art allows for no such transparency to the copyright creators.

Sample Embodiment 2

Another embodiment of the invention relates to visual images, which of course, involve at least two dimensions.

Similar to the goals of a psychoacoustic model, a psychovisual model attempts to represent a visual image with less data, and yet preserve those perceptual qualities that permit a human to recognize the original visual image. Using the very same techniques described above in connection with an audio signal, signal monitoring of visual images may be implemented.

One such application for monitoring and analyzing visual images involves a desire to find works of other artists that relate to a particular theme. For example, finding paintings of sunsets or sunrises. A traditional approach might involve a textual search involving a database wherein the works of other artists have been described in writing. The present invention, however, involves the scanning of an image involving a sun, compressing the data to its essential characteristics (i.e., those perceptual characteristics related to the sun) and then finding matches in a database of other visual images (stored as compressed or even uncompressed data). By studying the work of other artists using such techniques, a novice, for example, could learn much by comparing the presentations of a common theme by different artists.

Another useful application involving this type of monitoring and analyzing is the identification of photographs of potential suspects whose identity matches the sketch of a police artist.

Note that combinations of the monitoring techniques discussed above can be used for audio-visual monitoring, such as video-transmission by a television station or cable station. The techniques would have to compensate, for example, for a cable station that is broadcasting a audio channel unaccompanied by video.

Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The

specification and examples should be considered exemplary only with the true scope and spirit of the invention indicated by the following claims. As will be easily understood by those of ordinary skill in the art, variations and modifications of each of the disclosed embodiments can be easily made within the scope of this invention as defined by the following claims.

What is claimed:

1. An electronic system for monitoring and analyzing at least one signal, comprising:

a first input that receives at least one reference signal to be monitored,

a first processor that creates an abstract of each reference signal input to said first processor through said first input wherein the abstract comprises signal characteristic parameters configured to differentiate between a plurality of versions of the reference signal;

a second input that receives at least one query signal to be analyzed,

a second processor that creates an abstract of each query signal wherein the abstract comprises signal characteristic parameters of the query signal;

a reference database that stores abstracts of each at least one reference signal;

a comparing device that compares an abstract of said at least one query signal to the abstracts stored in the reference database to determine if the abstract of said at least one query signal matches any of the stored abstracts wherein a match indicates the query signal is a version of at least one of the reference signals.

2. The system of claim **1**, wherein said second input is remotely coupled to the system.

3. The system of claim **1**, wherein said second processor is remotely coupled to the system.

4. The system of claim **1**, wherein the system transmits the parameters that are being used by the first processor to the second processor.

5. The system of claim **1**, wherein the stored abstracts comprise a self-similar representation of at least one reference signal.

6. The system of claim **1**, wherein at least two of the stored abstracts comprise information corresponding to two versions of at least one reference signal.

7. The system of claim **1**, wherein the stored abstracts comprise data describing a portion of the characteristics of its associated reference signal.

8. The system of claim **7**, wherein the characteristics of the reference signal being described comprise at least one of a perceptible characteristic, a cognitive characteristic, a subjective characteristic, a perceptual quality, a recognizable characteristic or combinations thereof.

9. The system of claim **1**, wherein each stored abstract comprises data unique to each variation of its corresponding reference signal.

10. The system of claim **1**, wherein the system applies a cryptographic protocol to the abstract of said reference signal, said query signal, or both said reference signal and said query signal.

11. The system of claim **10**, wherein the cryptographic protocol is one of at least a hash or digital signature and further comprising storing the hashed abstract and/or digitally signed abstract.

12. The system of claim **1**, further comprising an embedder to embed uniquely identifiable data into at least one of the received reference signal, the received query signal or both the received reference signal and the received query signal.

13. The system of claim **1**, wherein the match indicates that the abstract of the query signal comprises the same perceptual characteristics as the abstract of the matched one of the reference signals.

14. The system of claim **1**, wherein the parameters comprise commonly perceptible features.

15. The system of claim **14**, wherein the commonly perceptible features are selected.

16. The system of claim **1**, wherein said first and said second processors are the same processor.

17. The system of claim **1**, wherein the first processor and the second processor are different processors.

18. A method for monitoring the distribution of data signals, comprising:

creating an abstract for a data signal wherein the data signal abstract comprises signal characteristic parameters configured to differentiate between a plurality of versions of the data signal;

storing the data signal abstract in at least one reference database;

receiving a query signal;

creating an abstract for the query signal based on the parameters;

comparing the created query signal abstract to the at least one database of data signal abstracts, each abstract in the at least one database corresponding to a version of the data signal; and

determining whether the query signal abstract matches any of the stored data signal abstracts in the at least one database to enable authorized transmission or use of the query signal for the query signal abstract based on whether a match was determined.

19. The method of claim **18**, wherein the database is created by at least one of a music company, a movie studio, an image archive, an owner of a general computing device, a user of the data signal, an internet service provider, an information technology company, a body politic, a telecommunications company and combinations thereof.

20. The method of claim **18**, wherein the data signals comprise at least one of images, audio, video, and combinations thereof.

21. The method of claim **18**, wherein the stored data signal abstracts are derived from one of a cognitive feature or a perceptible characteristic of the associated data signals.

22. The method of claim **18**, furthering comprising applying a cryptographic protocol to at least one created signal abstract, at least one database signal abstract or both at least one created signal abstract and at least one database signal abstract.

23. The method of claim **22**, wherein the cryptographic protocol comprises one of a hash or digital signature.

24. The method of claim **18**, wherein the stored signal abstracts comprise data to differentiate versions of the corresponding data signals.

25. The method of claim **18**, wherein each of the stored data signal abstracts comprise information configured to differentiate variations of each referenced corresponding data signal.

26. The method of claim **18**, further comprising storing information associated with the comparison step to enable at least one of a re-calibration of the database, a heuristic-based adjustment of the database, a computational efficiency adjustment of the database, an adjustment for database collisions and/or null cases, changes to the recognition or use parameters governing the database and combinations thereof.

27. The method of claim **18**, further comprising applying one of a relatedness index or measure of similarity to generate uniquely identifiable information to determine authorization.

28. The method of claim **18**, further comprising encoding information into the data signal with a watermarking technique.

29. The process of claim **18**, wherein the data signal is received by one of a creator or owner of said data signal.

30. A system for identifying and distributing signals, comprising:

a first input that receives a query abstract of a signal to identify;

a database containing a plurality of signal abstracts, the plurality of signal abstracts each associated with a corresponding signal wherein each of the plurality of the signal abstracts retains a perceptual relationship with the corresponding signal;

a comparing device that compares the query abstract to the plurality of abstracts stored in the reference database to identify a matching signal abstract; and

a device for retrieving the signal corresponding to the matching signal abstract; and

a device for conducting a transaction, the transaction selected from the group consisting of a download and a subscription.

31. The system of claim **30**, wherein each signal abstract comprises a link to its corresponding signal.

32. The system of claim **30**, wherein the comparing device determines if the signal abstracts stored in the database are authorized.

33. The system of claim **30**, wherein the comparing device determines if the link is an authorized link.

34. The system of claim **30**, wherein the reference database is governed by heuristics or experience-based parameters.

35. The system of claim **30**, wherein the plurality of abstracts stored in the reference database are derived from one of data reduced versions of said corresponding signals, compressed variations of said corresponding signals, bit-addressable relationships between said corresponding signals, and a least amount of data required to uniquely identify each corresponding signal, and combinations thereof.

36. The system of claim **30**, wherein the device for conducting transactions or the device for retrieving the signal is remotely coupled to the system.

37. The system of claim **30**, wherein the device for conducting transactions or the device for retrieving the signal is controlled by the database.

38. The system of claim **30**, wherein the device for retrieving the signal and the device for conducting transactions comprise the same device.

39. The system of claim **30**, further comprising an embedder to watermark signals with uniquely identifiable information.

40. A process for analyzing and identifying at least one signal, comprising:

receiving at least one reference signal to be identified,

creating an abstract of each reference signal received based on perceptual characteristics representative of parameters to differentiate between versions of the reference signal;

storing abstracts of each reference signal received in a database;

receiving at least one query signal to be identified,

creating an abstract of the received query signal based on the parameters; and

comparing an abstract of said received query signal to the abstracts stored in the database to determine if the abstract of said received query signal is related to any of the stored abstracts.

41. The process of claim **40**, wherein said database is independently accessible.

42. The process of claim **40**, wherein said received query signal is independently stored.

43. The process of claim **40**, wherein the criteria used to compare a received query signal abstract with a stored reference signal abstract are adjustable.

44. The process of claim **40**, wherein the stored abstracts comprise a self-similar representation of at least one reference signal.

45. The process of claim **40**, wherein at least two of the stored abstracts comprise information corresponding to two versions of at least one reference signal.

46. The process of claim **40**, wherein at least one abstract comprises data describing a portion of the characteristics of its associated reference signal.

47. The process of claim **46**, wherein the characteristics of the reference signal being described comprise at least one of a perceptible characteristic, a cognitive characteristic, a subjective characteristic, a perceptual quality, a recognizable characteristic or combinations thereof.

48. The process of claim **40**, wherein a stored abstract comprises data unique to a variation of its corresponding reference signal.

49. The process of claim **40**, wherein the process further comprises applying a cryptographic protocol to the abstract of said reference signal, said query signal, or both said reference signal and said query signal.

50. The process of claim **49**, wherein the cryptographic protocol is one of at least a hash or digital signature and further comprising storing the hashed abstract and/or digitally signed abstract.

51. The process of claim **40**, further comprising distributing at least one signal based on the comparison step.

52. The process of claim **51**, further comprising watermarking the at least one signal to be distributed.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,660,700 B2
APPLICATION NO. : 12/005229
DATED : February 9, 2010
INVENTOR(S) : Scott Moskowitz

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1 line 10 reading:
-- This application claims the benefit of pending U.S. patent --

should read:

-- This application is related to pending U.S. patent --

Signed and Sealed this
Thirteenth Day of September, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

US007949494B2

(12) **United States Patent**
Moskowitz et al.

(10) **Patent No.: US 7,949,494 B2**
(45) **Date of Patent: *May 24, 2011**

(54) **METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

(63) Continuation of application No. 12/005,229, filed on Dec. 26, 2007, now Pat. No. 7,660,700, which is a continuation of application No. 09/657,181, filed on Sep. 7, 2000, now Pat. No. 7,346,472.

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G06F 19/00 (2006.01)

(52) **U.S. Cl.** **702/182**; 707/E17.001; 707/E17.002; 707/E17.005; 707/E17.006; 709/209; 705/51; 380/28

(58) **Field of Classification Search** 702/182; 707/E17.001, E17.002, E17.005, E17.006; 709/209; 705/51, 57; 380/28, 248; 370/480; 348/E7.063, 460; 375/E7.075, E7.089; 382/248, 382/162, 232, 100
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,947,825 A		3/1976	Cassada
3,984,624 A		10/1976	Waggener
3,986,624 A		10/1976	Cates, Jr. et al.
4,038,596 A		7/1977	Lee
4,200,770 A		4/1980	Hellman et al.
4,218,582 A		8/1980	Hellman et al.
4,339,134 A		7/1982	Macheel
4,390,898 A		6/1983	Bond et al.
4,405,829 A		9/1983	Rivest et al.
4,424,414 A		1/1984	Hellman et al.
4,528,588 A		7/1985	Lofberg
4,672,605 A		6/1987	Hustig et al.
4,748,668 A		5/1988	Shamir et al.
4,789,928 A		12/1988	Fujisaki
4,827,508 A		5/1989	Shear
4,876,617 A		10/1989	Best et al.
4,896,275 A		1/1990	Jackson
4,908,873 A		3/1990	Philibert et al.
4,939,515 A		7/1990	Adelson
4,969,204 A		11/1990	Jones et al.
4,972,471 A		11/1990	Gross et al.
4,977,594 A		12/1990	Shear
4,979,210 A		12/1990	Nagata et al.
4,980,782 A		12/1990	Ginkel
5,050,213 A		9/1991	Shear
5,073,925 A		12/1991	Nagata et al.
5,077,665 A		12/1991	Silverman et al.
5,113,437 A		5/1992	Best et al.
5,136,581 A		8/1992	Muehrcke
5,136,646 A		8/1992	Haber et al.
5,136,647 A		8/1992	Haber et al.
5,142,576 A		8/1992	Nadan
5,161,210 A		11/1992	Druyvesteyn et al.
5,210,820 A	*	5/1993	Kenyon 704/200
5,243,423 A		9/1993	DeJean et al.
5,243,515 A		9/1993	Lee
5,287,407 A		2/1994	Holmes
5,319,735 A		6/1994	Preuss et al.
5,341,429 A		8/1994	Stringer et al.
5,341,477 A		8/1994	Pitkin et al.
5,363,448 A		11/1994	Koopman et al.
5,365,586 A		11/1994	Indeck et al.
5,369,707 A		11/1994	Follendore, III
5,379,345 A		1/1995	Greenberg
5,394,324 A		2/1995	Clearwater
5,398,285 A		3/1995	Borgelt et al.
5,406,627 A		4/1995	Thompson et al.
5,408,505 A		4/1995	Indeck et al.
5,410,598 A		4/1995	Shear
5,412,718 A		5/1995	Narasimhalv et al.
5,418,713 A		5/1995	Allen
5,428,606 A		6/1995	Moskowitz
5,450,490 A		9/1995	Jensen et al.
5,469,536 A		11/1995	Blank
5,471,533 A		11/1995	Wang et al.
5,478,990 A		12/1995	Montanari et al.
5,479,210 A		12/1995	Cawley et al.
5,487,168 A		1/1996	Geiner et al.
5,493,677 A		2/1996	Balogh et al.
5,497,419 A		3/1996	Hill

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0372601	6/1990

(Continued)

OTHER PUBLICATIONS

Schneier, Bruce, Applied Cryptography, 2nd Ed., John Wiley & Sons, pp. 9-10, 1996.

(Continued)

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(57) **ABSTRACT**

A method and system for monitoring and analyzing at least one signal are disclosed. An abstract of at least one reference signal is generated and stored in a reference database. An abstract of a query signal to be analyzed is then generated so that the abstract of the query signal can be compared to the abstracts stored in the reference database for a match. The method and system may optionally be used to record information about the query signals, the number of matches recorded, and other useful information about the query signals. Moreover, the method by which abstracts are generated can be programmable based upon selectable criteria. The system can also be programmed with error control software so as to avoid the re-occurrence of a query signal that matches more than one signal stored in the reference database.

29 Claims, No Drawings

U.S. PATENT DOCUMENTS

5,506,795	A	4/1996	Yamakawa
5,513,126	A	4/1996	Harkins et al.
5,513,261	A	4/1996	Maher
5,530,739	A	6/1996	Okada
5,530,751	A	6/1996	Morris
5,530,759	A	6/1996	Braudaway et al.
5,539,735	A	7/1996	Moskowitz
5,548,579	A	8/1996	Lebrun et al.
5,568,570	A	10/1996	Rabbani
5,579,124	A	11/1996	Aijala et al.
5,581,703	A	12/1996	Baugher et al.
5,583,488	A	12/1996	Sala et al.
5,598,470	A	1/1997	Cooper et al.
5,606,609	A	2/1997	Houser et al.
5,613,004	A	3/1997	Cooperman et al.
5,617,119	A	4/1997	Briggs et al.
5,625,690	A	4/1997	Michel et al.
5,629,980	A	5/1997	Stefik et al.
5,633,932	A	5/1997	Davis et al.
5,634,040	A	5/1997	Her et al.
5,636,276	A	6/1997	Brugger
5,636,292	A	6/1997	Rhoads
5,640,569	A	6/1997	Miller et al.
5,646,997	A	7/1997	Barton
5,657,461	A	8/1997	Harkins et al.
5,659,726	A	8/1997	Sandford, II et al.
5,664,018	A	9/1997	Leighton
5,673,316	A	9/1997	Auerbach et al.
5,677,952	A	10/1997	Blakley et al.
5,680,462	A	10/1997	Miller et al.
5,687,236	A	11/1997	Moskowitz et al.
5,689,587	A	11/1997	Bender et al.
5,696,828	A	12/1997	Koopman, Jr.
5,719,937	A	2/1998	Warren et al.
5,721,788	A	2/1998	Powell et al.
5,734,752	A	3/1998	Knox
5,737,416	A	4/1998	Cooper et al.
5,737,733	A	4/1998	Eller
5,740,244	A	4/1998	Indeck et al.
5,745,569	A	4/1998	Moskowitz et al.
5,748,783	A	5/1998	Rhoads
5,751,811	A	5/1998	Magnotti et al.
5,754,697	A	5/1998	Fu et al.
5,757,923	A	5/1998	Koopman, Jr.
5,765,152	A	6/1998	Erickson
5,768,396	A	6/1998	Sone
5,774,452	A	6/1998	Wolosewicz
5,790,677	A	8/1998	Fox et al.
5,799,083	A	8/1998	Brothers et al.
5,809,139	A	9/1998	Girod et al.
5,809,160	A	9/1998	Powell et al.
5,818,818	A	10/1998	Soumiya
5,822,432	A	10/1998	Moskowitz et al.
5,828,325	A	10/1998	Wolose Wicz et al.
5,832,119	A	11/1998	Rhoads
5,842,213	A	11/1998	Odom
5,848,155	A	12/1998	Cox
5,850,481	A	12/1998	Rhoads
5,859,920	A	1/1999	Daly et al.
5,860,099	A	1/1999	Milios et al.
5,862,260	A	1/1999	Rhoads
5,870,474	A	2/1999	Wasilewski et al.
5,884,033	A	3/1999	Duvall et al.
5,889,868	A	3/1999	Moskowitz et al.
5,893,067	A	4/1999	Bender et al.
5,894,521	A	4/1999	Conley
5,903,721	A	5/1999	Sixtus
5,905,800	A	5/1999	Moskowitz et al.
5,905,975	A	5/1999	Ausubel
5,912,972	A	6/1999	Barton
5,915,027	A	6/1999	Cox et al.
5,917,915	A	6/1999	Hirose
5,918,223	A	6/1999	Blum
5,920,900	A	7/1999	Poole et al.
5,923,763	A	7/1999	Walker et al.
5,930,369	A	7/1999	Cox et al.
5,930,377	A	7/1999	Powell et al.
5,940,134	A	8/1999	Wirtz
5,943,422	A	8/1999	Van Wie et al.
5,949,055	A *	9/1999	Fleet et al. 235/469
5,963,909	A	10/1999	Warren et al.
5,973,731	A	10/1999	Schwab
5,974,141	A	10/1999	Saito
5,991,426	A	11/1999	Cox et al.
5,999,217	A	12/1999	Berners-Lee
6,009,176	A	12/1999	Gennaro et al.
6,029,126	A	2/2000	Malvar
6,041,316	A	3/2000	Allen
6,044,471	A	3/2000	Colvin
6,049,838	A	4/2000	Miller et al.
6,051,029	A	4/2000	Paterson et al.
6,061,793	A	5/2000	Tewfik et al.
6,067,622	A	5/2000	Moore
6,069,914	A	5/2000	Cox
6,078,664	A	6/2000	Moskowitz et al.
6,081,251	A	6/2000	Sakai et al.
6,081,587	A	6/2000	Reyes et al.
6,081,597	A	6/2000	Hoffstein et al.
6,088,455	A *	7/2000	Logan et al. 380/200
6,131,162	A	10/2000	Yoshiura et al.
6,141,753	A	10/2000	Zhao et al.
6,141,754	A	10/2000	Choy
6,148,333	A	11/2000	Guedalia
6,154,571	A	11/2000	Cox et al.
6,192,138	B1	2/2001	Yamadaji
6,199,058	B1	3/2001	Wong et al.
6,205,249	B1	3/2001	Moskowitz
6,208,745	B1	3/2001	Florencio et al.
6,226,618	B1	5/2001	Downs
6,230,268	B1	5/2001	Miwa et al.
6,233,347	B1	5/2001	Chen et al.
6,233,684	B1	5/2001	Stefik et al.
6,240,121	B1	5/2001	Senoh
6,263,313	B1	7/2001	Milsted et al.
6,272,634	B1	8/2001	Tewfik et al.
6,275,988	B1	8/2001	Nagashima et al.
6,278,780	B1	8/2001	Shimada
6,278,791	B1	8/2001	Honsinger et al.
6,282,300	B1	8/2001	Bloom et al.
6,282,650	B1	8/2001	Davis
6,285,775	B1	9/2001	Wu et al.
6,301,663	B1	10/2001	Kato et al.
6,310,962	B1	10/2001	Chung et al.
6,330,335	B1	12/2001	Rhoads
6,330,672	B1	12/2001	Shur
6,345,100	B1	2/2002	Levine
6,351,765	B1	2/2002	Pietropaolo et al.
6,363,483	B1	3/2002	Keshav
6,373,892	B1	4/2002	Ichien et al.
6,373,960	B1	4/2002	Conover et al.
6,374,036	B1	4/2002	Ryan et al.
6,377,625	B1	4/2002	Kim
6,381,618	B1	4/2002	Jones et al.
6,381,747	B1	4/2002	Wonfor et al.
6,385,324	B1	5/2002	Koppen
6,385,329	B1 *	5/2002	Sharma et al. 382/100
6,385,596	B1	5/2002	Wiser
6,389,538	B1	5/2002	Gruse et al.
6,405,203	B1	6/2002	Collart
6,415,041	B1	7/2002	Oami et al.
6,418,421	B1	7/2002	Hurtado
6,425,081	B1	7/2002	Iwamura
6,430,301	B1	8/2002	Petrovic
6,430,302	B2	8/2002	Rhoads
6,442,283	B1	8/2002	Tewfik et al.
6,446,211	B1	9/2002	Colvin
6,453,252	B1	9/2002	Laroche
6,457,058	B1	9/2002	Ullum et al.
6,463,468	B1	10/2002	Buch et al.
6,484,264	B1	11/2002	Colvin
6,493,457	B1	12/2002	Quackenbush
6,502,195	B1	12/2002	Colvin
6,522,767	B1	2/2003	Moskowitz et al.
6,522,769	B1	2/2003	Rhoads et al.
6,523,113	B1	2/2003	Wehrenberg
6,668,325	B1	2/2003	Collberg et al.
6,530,021	B1	3/2003	Epstein et al.

6,532,284	B2	3/2003	Walker et al.	
6,539,475	B1	3/2003	Cox et al.	
6,557,103	B1	4/2003	Boncelet, Jr. et al.	
6,584,125	B1	6/2003	Katto	
6,587,837	B1	7/2003	Spagna et al.	
6,590,996	B1 *	7/2003	Reed et al.	382/100
6,598,162	B1	7/2003	Moskowitz	
6,606,393	B1	8/2003	Xie et al.	
6,647,424	B1	11/2003	Pearson et al.	
6,658,010	B1	12/2003	Enns et al.	
6,665,489	B2	12/2003	Collart	
6,668,246	B1	12/2003	Yeung et al.	
6,674,858	B1	1/2004	Kimura	
6,687,683	B1	2/2004	Harada et al.	
6,725,372	B1	4/2004	Lewis et al.	
6,754,822	B1	6/2004	Zhao	
6,775,772	B1	8/2004	Binding et al.	
6,784,354	B1	8/2004	Lu et al.	
6,785,815	B1	8/2004	Serret-Avila et al.	
6,785,825	B2	8/2004	Colvin	
6,792,548	B2	9/2004	Colvin	
6,792,549	B2	9/2004	Colvin	
6,795,925	B2	9/2004	Colvin	
6,799,277	B2	9/2004	Colvin	
6,813,717	B2	11/2004	Colvin	
6,813,718	B2	11/2004	Colvin	
6,823,455	B1	11/2004	Macy et al.	
6,834,308	B1	12/2004	Ikezoye et al.	
6,842,862	B2	1/2005	Chow et al.	
6,853,726	B1	2/2005	Moskowitz et al.	
6,857,078	B2	2/2005	Colvin	
6,931,534	B1	8/2005	Jandel et al.	
6,957,330	B1	10/2005	Hughes	
6,966,002	B1	11/2005	Torrubia-Saez	
6,983,337	B2	11/2005	Wold	
6,977,894	B1	12/2005	Achilles et al.	
6,978,370	B1	12/2005	Kocher	
6,986,063	B2	1/2006	Colvin	
6,990,453	B2	1/2006	Wang	
7,007,166	B1	2/2006	Moskowitz et al.	
7,020,285	B1	3/2006	Kirovski et al.	
7,035,049	B2	4/2006	Yamamoto	
7,035,409	B1	4/2006	Moskowitz	
7,043,050	B2	5/2006	Yuval	
7,046,808	B1	5/2006	Metois et al.	
7,050,396	B1	5/2006	Cohen et al.	
7,051,208	B2	5/2006	Venkatesan et al.	
7,058,570	B1	6/2006	Yu et al.	
7,093,295	B1	8/2006	Saito	
7,095,874	B2	8/2006	Moskowitz et al.	
7,103,184	B2	9/2006	Jian	
7,107,451	B2	9/2006	Moskowitz	
7,123,718	B1	10/2006	Moskowitz et al.	
7,127,615	B2	10/2006	Moskowitz	
7,150,003	B2	12/2006	Naumovich et al.	
7,152,162	B2	12/2006	Moskowitz et al.	
7,159,116	B2	1/2007	Moskowitz	
7,162,642	B2	1/2007	Schumann et al.	
7,177,429	B2	2/2007	Moskowitz et al.	
7,177,430	B2	2/2007	Kim	
7,206,649	B2	4/2007	Kirovski et al.	
7,231,524	B2	6/2007	Burns	
7,233,669	B2	6/2007	Candelore	
7,240,210	B2	7/2007	Michak et al.	
7,266,697	B2	9/2007	Kirovski et al.	
7,286,451	B2	10/2007	Wirtz et al.	
7,287,275	B2	10/2007	Moskowitz	
7,289,643	B2	10/2007	Brunk et al.	
7,343,492	B2	3/2008	Moskowitz et al.	
7,346,472	B1	3/2008	Moskowitz et al.	
7,362,775	B1	4/2008	Moskowitz	
7,363,278	B2	4/2008	Schmelzer et al.	
7,409,073	B2	8/2008	Moskowitz et al.	
7,457,962	B2	11/2008	Moskowitz	
7,460,994	B2	12/2008	Herre et al.	
7,475,246	B1	1/2009	Moskowitz	
7,530,102	B2	5/2009	Moskowitz	
7,532,725	B2	5/2009	Moskowitz et al.	
7,568,100	B1	7/2009	Moskowitz et al.	

7,647,502	B2	1/2010	Moskowitz	
7,647,503	B2	1/2010	Moskowitz	
7,664,263	B2	2/2010	Moskowitz	
7,743,001	B1	6/2010	Vermeulen	
7,761,712	B2	6/2010	Moskowitz	
7,779,261	B2	8/2010	Moskowitz	
2001/0010078	A1	7/2001	Moskowitz	
2001/0029580	A1	10/2001	Moskowitz	
2001/0043594	A1 *	11/2001	Ogawa et al.	370/356
2002/0009208	A1 *	1/2002	Alattar et al.	382/100
2002/0010684	A1	1/2002	Moskowitz	
2002/0026343	A1	2/2002	Duenke	
2002/0056041	A1	5/2002	Moskowitz	
2002/0047873	A1	6/2002	Petrovic	
2002/0071556	A1	6/2002	Moskowitz et al.	
2002/0073043	A1	6/2002	Herman et al.	
2002/0097873	A1	7/2002	Petrovic	
2002/0103883	A1	8/2002	Haverstock et al.	
2002/0161741	A1	10/2002	Wang et al.	
2003/0126445	A1	7/2003	Wehrenberg	
2003/0133702	A1	7/2003	Collart	
2003/0200439	A1	10/2003	Moskowitz	
2003/0219143	A1	11/2003	Moskowitz et al.	
2004/0028222	A1	2/2004	Sewell et al.	
2004/0037449	A1	2/2004	Davis et al.	
2004/0049695	A1	3/2004	Choi et al.	
2004/0059918	A1	3/2004	Xu	
2004/0083369	A1	4/2004	Erlingsson et al.	
2004/0086119	A1	5/2004	Moskowitz	
2004/0093521	A1	5/2004	Hamadeh et al.	
2004/0117628	A1	6/2004	Colvin	
2004/0117664	A1	6/2004	Colvin	
2004/0125983	A1	7/2004	Reed et al.	
2004/0128514	A1	7/2004	Rhoads	
2004/0225894	A1	11/2004	Colvin	
2004/0243540	A1	12/2004	Moskowitz et al.	
2005/0135615	A1	6/2005	Moskowitz et al.	
2005/0160271	A9	7/2005	Brundage et al.	
2005/0177727	A1	8/2005	Moskowitz et al.	
2005/0246554	A1	11/2005	Batson	
2006/0005029	A1	1/2006	Petrovic et al.	
2006/0013395	A1	1/2006	Brundage et al.	
2006/0013451	A1	1/2006	Haitsma	
2006/0041753	A1	2/2006	Haitsma	
2006/0101269	A1	5/2006	Moskowitz et al.	
2006/0140403	A1	6/2006	Moskowitz	
2006/0251291	A1	11/2006	Rhoads	
2006/0285722	A1	12/2006	Moskowitz et al.	
2007/0011458	A1	1/2007	Moskowitz	
2007/0028113	A1	2/2007	Moskowitz	
2007/0064940	A1	3/2007	Moskowitz et al.	
2007/0079131	A1	4/2007	Moskowitz et al.	
2007/0083467	A1	4/2007	Lindahl et al.	
2007/0110240	A1	5/2007	Moskowitz et al.	
2007/0113094	A1	5/2007	Moskowitz et al.	
2007/0127717	A1	6/2007	Herre et al.	
2007/0226506	A1	9/2007	Moskowitz	
2007/0253594	A1	11/2007	Lu et al.	
2007/0294536	A1	12/2007	Moskowitz et al.	
2007/0300072	A1	12/2007	Moskowitz	
2007/0300073	A1	12/2007	Moskowitz	
2008/0005571	A1	1/2008	Moskowitz	
2008/0005572	A1	1/2008	Moskowitz	
2008/0016365	A1	1/2008	Moskowitz	
2008/0022113	A1	1/2008	Moskowitz	
2008/0022114	A1	1/2008	Moskowitz	
2008/0028222	A1	1/2008	Moskowitz	
2008/0046742	A1	2/2008	Moskowitz	
2008/0075277	A1	3/2008	Moskowitz et al.	
2008/0109417	A1	5/2008	Moskowitz	
2008/0133927	A1	6/2008	Moskowitz et al.	
2008/0151934	A1	6/2008	Moskowitz et al.	
2009/0037740	A1	2/2009	Moskowitz	
2009/0089427	A1	4/2009	Moskowitz et al.	
2009/0190754	A1	7/2009	Moskowitz et al.	
2009/0210711	A1	8/2009	Moskowitz	
2009/0220074	A1	9/2009	Moskowitz et al.	
2010/0002904	A1	1/2010	Moskowitz	
2010/0005308	A1	1/2010	Moskowit	

2010/0064140	A1	3/2010	Moskowitz
2010/0077219	A1	3/2010	Moskowitz
2010/0077220	A1	3/2010	Moskowitz
2010/0098251	A1	4/2010	Moskowitz
2010/0106736	A1	4/2010	Moskowitz
2010/0153734	A1	6/2010	Moskowitz
2010/0182570	A1	7/2010	Chota
2010/0202607	A1	8/2010	Moskowitz
2010/0220861	A1	9/2010	Moskowitz

FOREIGN PATENT DOCUMENTS

EP	0372601	A1	6/1990
EP	0565947		10/1993
EP	0565947	A1	10/1993
EP	0581317		2/1994
EP	0581317	A2	2/1994
EP	0649261		4/1995
EP	0651554		5/1995
EP	0651554	A	5/1995
EP	0872073		7/1996
EP	1547337		3/2006
EP	1354276		12/2007
EP	1354276	B1	12/2007
NL	100523		9/1998
NL	1005523		9/1998
WO	WO 95/14289		5/1995
WO	WO 9514289		5/1995
WO	WO9701892		6/1995
WO	WO 96/29795		9/1996
WO	WO 9629795		9/1996
WO	WO 9642151		12/1996
WO	WO9726733		1/1997
WO	WO 97/24833		7/1997
WO	WO 9724833		7/1997
WO	WO9726732		7/1997
WO	WO 9744736		11/1997
WO	WO9802864		1/1998
WO	WO98/37513		8/1998
WO	WO9837513		8/1998
WO	WO 9952271		10/1999
WO	WO 99/62044		12/1999
WO	WO 9962044		12/1999
WO	WO 9963443		12/1999
WO	WO 0057643		9/2000
WO	WO0118628		3/2001
WO	WO0143026		6/2001
WO	WO0203385		1/2002
WO	WO02003385	A1	10/2002

OTHER PUBLICATIONS

Menezes, Alfred J., Handbook of Applied Crypography, CRC Press, p. 46, 1997.
Brealy, et al., Principles of Corporate Finance, "Appendix A—Using Option Valuation Models", 1984, pp. 448-449.
Copeland, et al., Real Options:A Practioner's Guide, 2001 pp. 106-107, 201-202, 204-208.
Sarkar, M. "An Assessment of Pricing Mechanisms for the Internet-A Regulatory Imperative", presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/ien/works/SarkAsses.html on.
Crawford, D.W. "Pricing Network Usage:A Market for Bandwith of Market Communication?" presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/ien/works/CrawMarket.html on March.
Low, S.H., "Equilibrium Allocation and Pricing of Variable Resources Among User-Suppliers", 1988. http://www.citesear.nj.nec.com/366503.html.
Caronni, Germano, "Assuring Ownership Rights for Digital Images", published proceeds of reliable IT systems, v15 '95, H.H. Bruggemann and W Gerhardt-Hackel (Ed.) Viewing Publishing Company Germany 1995.
Zhao, Jian. "A WWW Service to Embed and Prove Digital Copyright Watermarks", Proc. of the european conf. on Mulitmedia Applications, Services & Techinques Louvain-La-Nevve Belgium May 1996.
Gruhl,Daniel et al.,Echo Hiding. In Proceeding of the Workshop on Information Hiding. No. 1174 in Lecture Notes in Computer Science, Cambridge, England (May/Jun. 1996).
Oomen,A.W.J. et al., A Variable Bit Rate Buried Data Channel for Compact Disc, J.Audio Eng.Sc.,vol. 43,No. 1/2,pp. 23-28 (1995).
Ten Kate,W: et al., A New Surround-Stereo—Surround Coding Techniques, J. Audio Eng.Soc.,vol. 40,No. 5,pp. 376-383 (1992).
Gerzon, Michael et al., A High Rate Buried Data Channel for Audio CD, presentation notes, Audio Engineering Soc. 94th Convention (1993).
Sklar,Bernard, Digital Communications, pp. 601-603 (1988).
Jayant, N.S. et al., Digital Coding of Waveforms, Prentice Hall Inc., Englewood Cliffs,NJ, pp. 486-509 (1984).
Bender, Walter R. et al., Techniques for Data Hiding, SPIE Int. Soc. Opt. Eng., vol. 2420, pp. 164-173, 1995.
Zhao, Jian et al., Embedding Robust Labels into Images for Copyright Protection, (xp 000571976), pp. 242-251, 1995.
Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 175, 1997.
Schneier, Bruce, Applied Cryptography, 1st Ed., pp. 67-68, 1994.
ten Kate, W. et al., "Digital Audio Carrying Extra Information", IEEE, CH 2847-2/90/000-1097, (1990).
van Schyndel, et al. A digital Watermark, IEEE Int'l Computer Processing Conference, Austin,TX, Nov. 13-16, 1994, pp. 86-90.
Smith, et al. Modulation and Information Hiding in Images, Springer Verlag, 1st Int'l Workshop, Cambridge, UK, May 30-Jun. 1, 1996, pp. 207-227.
Puate, Joan et al., Using Fractal Compression Scheme to Embed a Digital Signature into an Image, SPIE-96 Proceedings, vol. 2915, Mar. 1997, pp. 108-118.
Swanson, Mitchell D.,et al., Transparent Robust Image Watermarking, Proc. of the 1996 IEEE Int'l Conf. on Image Processing, vol. 111, 1996, pp. 211-214.
Swanson, Mitchell D. et al. Robust Data Hiding for Images, 7th IEEE Digital Signal Processing Workshop, Leon, Norway. Sep. 1-4, 1996, pp. 37-40.
Zhao, Jian et al., Embedding Robust Labels into Images for Copyright Protection, Proceeding of the Know Right '95 Conference, pp. 242-251.
Koch, E., et al., Towards Robust and Hidden Image Copyright Labeling, 1995 IEEE Workshop on Nonlinear Signal and Image Processing, Jun. 1995 Neos Marmaras p. 4.
Van Schyandel, et al. Towards a Robust Digital Watermark, Second Asain Image Processing Conference, Dec. 6-8, 1995,Singapore, vol. 2,pp. 504-508.
Tirkel,A.Z., A Two-Dimensional Digital Watermark, DICTA '95, Univ. of Queensland, Brisbane, Dec. 5-8, 1995, pp. 7.
Tirkel,A.Z., Image Watermarking—A Spread Spectrum Application, ISSSTA '96, Sep. 1996, Mainz, German, pp. 6.
O'Ruanaidh, et al. Watermarking Digital Images for Copyright Protection, IEEE Proceedings, vol. 143, No. 4, Aug. 1996, pp. 250-256.
Cox, et al., Secure Spread Spectrum Watermarking for Multimedia, NEC Research Institude, Techinal Report 95-10, p. 33.
Kahn, D., The Code Breakers, The MacMillan Company, 1969, pp. xIII, 81-83,513,515,522-526,873.
Boney, et al., Digital Watermarks for Audio Signals, EVSIPCO, 96, pp. 473-480.
Dept. of Electrical Engineering, Del Ft University of Technology, Del ft The Netherlands,Cr.C. Langelaar et al.,Copy Protection for Mulitmedia Data based on Labeling Techniques Jul. 1996 9 pp.
Craver, et al., Can Invisible Watermarks Resolve Rightful Ownerships? IBM Research Report, RC 20509 (Jul. 25, 1996) 21 pp.
Press, et al., Numerical Recipes in C, Cambridge Univ. Press, 1988, pp. 398-417.
Pohlmann, Ken C., Principles of Digital Audio, 3rd Ed., 1995, pp. 32-37, 40-48,138,147-149,332,333,364, 499-501,508-509,564-571.
Pohlmann, Ken C., Principles of Digital Audio, 2nd Ed., 1991, pp. 1-9,19-25,30-33,41-48,54-57,86-107,375-387.
Schneier, Bruce, Applied Cryptography, John Wiley & Sons, inc., New York, 1994, pp. 68,69,387-392,1-57,273-275,321-324.
Boney, et al., Digital Watermarks for Audio Signals, Proceedings of the International Conf. on Multimedia Computing and Systems, Jun. 17-23, 1996, Hiroshima, Japan, 0-8186-7436-9196, pp. 473-480.

Johnson, et al., Transform Permuted Watermarking for Copyright Protection of Digital Video, IEEE Globecom 1998, Nov. 8-12, 1998, New York, New York, vol. 2, 1998, pp. 684-689,(ISBN 0-7803-4985-7).
Rivest, et al., "Pay Word and Micromint: Two Simple Micropayment Schemes," MIT Laboratory for Computer Science, Cambridge, MA, May 7, 1996, pp. 1-18.
Bender, et al., Techniques for Data Hiding, IBM Systems Journal, vol. 35, Nos. 3 & 4, 1996,pp. 313-336.
Moskowitz, Bandwith as Currency, IEEE Multimedia, Jan.-Mar. 2003, pp. 14-21.
Moskowitz, Multimedia Security Technologies for Digital Rights Management, 2006, Academic Press, "Introduction-Digital Rights Management" pp. 3-22.
Moskowitz, "What is Acceptable Quality in the Application of Digital Watermarking: Trade-offs of Security, Robustness and Quality", IEEE Computer Society Proceedings of ITCC 2002 Apr. 10, 2002 pp. 80-84.
Lemma, et al. "Secure Watermark Embedding through Partial Encryption", International Workshop on Digital Watermarking ("IWDW" 2006), Springer Lecture Notes in Computer Science,2006, (to appear) 13.
Kocher, et al., "Self Protecting Digital Content", Technical Report from the CRI Content Security Research Initiative, Crytography Research, Inc. 2002-2003, 14 pages.
Sirbu, M. et al., "Net Bill: An Internet Commerce System Optimized for Network Delivered Services", Digest of Papers of the Computer Society Computer Conference (Spring), Mar. 5, 1995, pp. 20-25, vol. CONF40.
Schunter, M. et al., "A Status Report on the SEMPER framework for Secure Electronic Commerce", Computer Networks and ISDN Systems, Sep. 30, 1998, pp. 1501-1510, vol. 30, No. 16-18, NI, North Holland.
Konrad, K. et al., "Trust and Elecronic Commerce-more than a techinal problem," Proceedings of the 18th IEEE Symposium on Reliable Distributed Systems Oct. 19-22, 1999 pp. 360-365 Lausanne.
Kini, A. et al., "Trust in Electronic Commerce: Definition and Theoretical Considerations", Proceedings of the 31st Hawaii Int'l Conf on System Sciences (Cat. No. 98TB100216), Jan. 6-9, 1998, pp. 51-61, Los.
Steinauer D. D., et al., "Trust and Traceability in Electronic Commerce", Standard View, Sep. 1997, pp. 118-124, vol. 5 No. 3, ACM, USA.
Hartung, et al. "Multimedia Watermarking Techniques", Proceedings of the IEEE, Special Issue, Identification & Protection of Multimedia Information, pp. 1079-1107 Jul. 1999 vol. 87 No. 7 IEEE.
Rivest,et al., PayWord and MicroMint: Two simple micropayment schemes, MIT Laboratory for Computer Science, Cambridge, MA 02139, Apr. 27, 2001, pp. 1-18.
Horowitz, et al., The Art of Electronics, 2nd Ed., 1989, pp. 7.
Delaigle, J.-F., et al. "Digital Watermarking," Proceedings of the SPIE, vol. 2659, Feb 1, 1996, pp. 99-110 (Abstract).
Schneider, M., et al. "Robust Content Based Digital Signature for Image Authentication," Proceedings of the International Conference on Image Processing (IC. Lausanne), Sep. 16-19, 1996, pp. 227-230, IEEE ISBN.
Cox, I. J., et al. "Secure Spread Spectrum Watermarking for Multimedia," IEEE Transactions on Image Processing, vol. 6 No. 12, Dec. 1, 1997, pp. 1673-1686.
Wong, Ping Wah. "A Public Key Watermark for Image Verification and Authentication," IEEE International Conference on Image Processing, vol. 1, Oct. 4-7, 1998, pp. 455-459.
Fabien A.P. Petitcolas, Ross J. Anderson and Markkus G. Kuhn, "Attacks on Copyright Marking Systems," LNCS, vol. 1525, Apr. 14-17, 1998, pp. 218-238, ISBN: 3-540-65386-4.
Ross Anderson, "Stretching the Limits of Steganography," LNCS, vol. 1174, May/Jun. 1996, 10 pages, ISBN: 3-540-61996-8.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Image Watermarking", pre-publication, Summer 1997 4 pages.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Image Watermarking", Submitted to Signal Processing Aug. 21, 1997 19 pages.
Rivest, R. "Chaffing and Winnowing: Confidentiality without Encryption", MIT Lab for Computer Science, http://people.csail.mit.edu/rivest/ Chaffing.txt, Apr. 24, 1998, 9 pp.
PortalPlayer, PP502 digital media management system-on-chip, May 1, 2003, 4 pp.
VeriDisc, "The search for a Rational Solution to Digital Rights Management (DRM)", http://64.244.235.240/news/whitepaper/docs/veridisc_white_paper.pdf, 2001, 15 pp.
Cayre, et al., "Kerckhoff's-Based Embedding Security Classes for WOA Data Hiding". IEEE Transactions on Information Forensics and Security, vol. 3 No. 1, Mar. 2008, 15 pp.
Wayback Machine, dated Jan. 17, 1999, http://vveb.archive.org/web/19990117020420/http://www.netzero.com/, accessed on Feb. 19, 2008.
Namgoong, H., "An Integrated Approach to Legacy Data for Multimedia Applications", Proceedings of the 23rd EUROMICRO Conference, vol., Issue 1-4, Sep. 1997, pp. 387-391.
Wayback Machine, dated Aug. 26, 2007, http://web.archive.org/web/20070826151732/http://www.screenplaysmag.com/tabid/96/articleType/ArticleView/articleId/495/Default.aspx/.
"YouTube Copyright Policy: Video Identification tool—YouTube Help", accessed Jun. 4, 2009, http://www.google.com/support/youtube/bin/answer.py?h1=en&answer=83766, 3 pp.
PCT International Search Report, completed Sep. 13, 1995; authorized officer Huy D. Vu (PCT/US95/08159) (2 pages).
PCT International Search Report, completed Jun. 11, 1996; authorized officer Salvatore Cangialosi (PCT/US96/10257) (4 pages).
Supplementary European Search Report, completed Mar. 5, 2004; authorized officer J. Hazel (EP 96 91 9405) (1 page).
PCT International Search Report, completed Apr. 4, 1997; authorized officer Bernarr Earl Gregory (PCT/US97/00651) (1 page).
PCT International Search Report, completed May 6, 1997; authorized officer Salvatore Cangialosi (PCT/US97/00652) (3 pages).
PCT International Search Report, completed Oct. 23, 1997; authorized officer David Cain (PCT/US97/11455) (1 page).
PCT International Search Report, completed Jul. 12, 1999; authorized officer R. Hubeau (PCT/US99/07262) (3 pages).
PCT International Search Report, completed Jun. 30, 2000; authorized officer Paul E. Callahan (PCT/US00/06522) (7 pages).
Supplementary European Search Report, completed Jun. 27, 2002; authorized officer M. Schoeyer (EP 00 91 9398) (1 page).
PCT International Search Report, date of mailing Mar. 15, 2001; authorized officer Marja Brouwers (PCT/US00/18411) (5 pages).
PCT International Search Report, completed Jul. 20, 2001; authorized officer A. Sigolo (PCT/US00/18411) (5 pages).
PCT International Search Report, completed Mar. 20, 2001; authorized officer P. Corcoran (PCT/US00/33126) (6 pages).
PCT International Search Report, completed Jan. 26, 2001; authorized officer G. Barron (PCT/US00/21189) (3 pages).
European Search Report, completed Oct. 15, 2007; authorized officer James Hazel (EP 07 11 2420) (9 pages).
STAIND (The Singles 1996-2006), Warner Music—Atlantic, Pre-Release CD image, 2006, 1 page.
Arctic Monkeys (Whatever People Say I Am, That's What I'm Not), Domino Recording Co. Ltd., Pre-Release CD image, 2005, 1 page.
Radiohead ("Hail To The Thief"), EMT Music Group—Capitol, Pre-Release CD image, 2003, 1 page.
OASIS (Dig Out Your Soul), Big Brother Recordings Ltd., Promotion CD image, 2009, 1 page.
U.S. Appl. No. 08/999,766, filed Jul. 23, 1997, entitled "Steganographic Method and Device", published as 7568100 Jul. 28, 2009.
EPO Application No. 96919405.9, entitled "Steganographic Method and Device"; published as EP0872073 (A2), Oct. 21, 1998.
U.S. Appl. No. 11/050,779, filed Feb. 7, 2005, entitled "Steganographic Method and Device", published as 20050177727 A1 Aug. 11, 2005.
U.S. Appl. No. 08/674,726, filed Jul. 2, 1996, entitled "Exchange Mechanisms for Digital Information Packages with Bandwidth

Securitization, Multichannel Digital Watermarks, and Key Management", published as 7362775 Apr. 22, 2008.
U.S. Appl. No. 09/545,589, filed Apr. 7, 2000, entitled "Method and System for Digital Watermarking", published as 7007166 Feb. 28, 2006.
U.S. Appl. No. 11/244,213, filed Oct. 5, 2005, entitled "Method and System for Digital Watermarking", published as 2006-0101269 A1 May 11, 2006, cited herein as P36.
U.S. Appl. No. 11/649,026, filed Jan. 3, 2007, entitled "Method and System for Digital Watermarking", published as 2007-0113094 A1 May 17, 2007.
U.S. Appl. No. 09/046,627, filed Mar. 24, 1998, entitled "Method for Combining Transfer Function with Predetermined Key Creation", published as 6,598,162 Jul. 22, 2003.
U.S. Appl. No. 10/602,777, filed Jun. 25, 2003, entitled "Method for Combining Transfer Function with Predetermined Key Creation", published as 2004-0086119 A1 May 6, 2004.
U.S. Appl. No. 09/053,628, filed Apr. 2, 1998, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", 6,205,249 Mar. 20, 2001.
U.S. Appl. No. 09/644,098, filed Aug. 23, 2000, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", published as 7,035,409 Apr. 25, 2006.
Jap. App. No. 2000-542907, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking"; which is a JP national stage of PCT/US1999/007262, published as WO/1999/052271, Oct. 14, 1999.
U.S. Appl. No. 09/767,733, filed Jan. 24, 2001 entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", published as 2001-0010078 A1 Jul. 26, 2001.
U.S. Appl. No. 11/358,874, filed Feb. 21, 2006, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", published as 2006-0140403 A1 Jun. 29, 2006.
U.S. Appl. No. 10/417,231, filed Apr. 17, 2003, entitled "Methods, Systems And Devices For Packet Watermarking And Efficient Provisioning Of Bandwidth", published as 2003-0200439 A1 Oct. 23, 2003.
U.S. Appl. No. 09/789,711, filed Feb. 22, 2001, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2001-0029580 A1 Oct. 11, 2001.
U.S. Appl. No. 11/497,822, filed Aug. 2, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2007-0011458 A1 Jan. 11, 2007.
U.S. Appl. No. 11/599,964, filed Nov. 15, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2008-0046742 A1 Feb. 21, 2008.
U.S. Appl. No. 11/599,838, filed Nov. 15, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2007-0226506 A1 Sep. 27, 2007.
U.S. Appl. No. 10/369,344, filed Feb. 18, 2003, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data", published as 2003-0219143 A1 Nov. 27, 2003.
U.S. Appl. No. 11/482,654, filed Jul. 7, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data", published as 2006-0285722 A1 Dec. 21, 2006.
U.S. Appl. No. 09/594,719, filed Jun. 16, 2000, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as 7,123,718 Oct. 17, 2006.
U.S. Appl. No. 11/519,467, filed Sep. 12, 2006, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as 2007-0064940 A1 Mar. 22, 2007.
U.S. Appl. No. 09/731,040, filed Dec. 7, 2000, entitled "Systems, Methods And Devices For Trusted Transactions", 2002-0010684 A1 Jan. 24, 2002.
U.S. Appl. No. 11/512,701, filed Aug. 29, 2006, entitled "Systems, Methods and Devices for Trusted Transactions", published as 2007-0028113 A1 Feb. 1, 2007.
U.S. Appl. No. 10/049,101, filed Feb. 8, 2002, entitled "A Secure Personal Content Server", published as 7,475,246 Jan. 6, 2009.
PCT Application No. PCT/US00/21189, filed Aug. 4, 2000, entitled, "A Secure Personal Content Server", Pub. No. WO/2001/018628 ; Publication Date: Mar. 15, 2001.
U.S. Appl. No. 09/657,181, filed Sep. 7, 2000, entitled "Method and Device For Monitoring And Analyzing Signals", published as 7,346,472 Mar. 18, 2008.
U.S. Appl. No. 10/805,484, filed Mar. 22, 2004, entitled "Method And Device For Monitoring And Analyzing Signals", published as 2004-0243540 A1 Dec. 2, 2004.
U.S. Appl. No. 09/956,262, filed Sep. 20, 2001, entitled "Improved Security Based on Subliminal and Supraliminal Channels For Data Objects", published as 2002-0056041 A1 May 9, 2002.
U.S. Appl. No. 11/518,806, filed Sep. 11, 2006, entitled "Improved Security Based on Subliminal and Supraliminal Channels For Data Objects", 2008-0028222 A1 Jan. 31, 2008.
U.S. Appl. No. 11/026,234, filed Dec. 30, 2004, entitled "Z-Transform Implementation of Digital Watermarks", published as 2005-0135615 A1 Jun. 23, 2005.
U.S. Appl. No. 11/592,079, filed Nov. 2, 2006, entitled "Linear Predictive Coding Implementation of Digital Watermarks", published as 2007-0079131 A1 Apr. 5, 2007.
U.S. Appl. No. 09/731,039, filed Dec. 7, 2000, entitled "System and Methods for Permitting Open Access to Data Objects and for Securing Data within the Data Objects", published as 2002-0071556 A1 Jun. 13, 2002.
U.S. Appl. No. 11/647,861, filed Dec. 29, 2006, entitled "System and Methods for Permitting Open Access to Data Objects and for Securing Data within the Data Objects", published as 2007-0110240 A1 May 17, 2007.
Merriam-Webster's Collegiate Dictionary, 10th Ed., Merriam Webster, Inc., p. 207.
Van Schyndel, et al., "A digital Watermark," IEEE Int'l Computer Processing Conference, Austin,TX, Nov. 13-16, 1994, pp. 86-90.
Kutter, Martin et al., "Digital Signature of Color Images Using Amplitude Modulation", SPIE-E197, vol. 3022, pp. 518-527.
Tomsich, et al., "Towards a secure and de-centralized digital watermarking infrastructure for the protection of Intellectual Property", in Electronic Commerce and Web Technologies, Proceedings (ECWEB)(2000).
Kini, et al., "Trust in Electronic Commerce: Definition and Theoretical Considerations", Proceedings of the 31st Hawaii Int'l Conf on System Sciences (Cat. No. 98TB100216). Jan. 6-9, 1998. pp. 51-61. Los.
U.S. Appl. No. 60/169,274, filed Dec. 7, 1999, entitled "Systems, Methods And Devices For Trusted Transactions".
U.S. Appl. No. 60/234,199, filed Sep. 20, 2000, "Improved Security Based on Subliminal and Supraliminal Channels for Data Objects".
U.S. Appl. No. 09/671,739, filed Sep. 29, 2000, entitled "Method And Device For Monitoring And Analyzing Signals".
Tirkel, A.Z., "A Two-Dimensional Digital Watermark", Scientific Technology, 686, 14, date unknown.
PCT International Search Report in PCT/US95/08159.
PCT International Search Report in PCT/US96/10257.
PCT International Search Report in PCT/US97/00651.
PCT International Search Report in PCT/US97/00652.
PCT International Search Report in PCT/US97/11455.
PCT International Search Report in PCT/US99/07262.
PCT International Search Report in PCT/US00/06522.
PCT International Search Report in PCT/US00/18411.
PCT International Search Report in PCT/US00/33126.
PCT International Search Report in PCT/US00/21189.
Delaigle, J.-F., et al. "Digital Watermarking," Proceedings of the SPIE, vol. 2659, Feb 1, 1996, pp. 99-110.
U.S. Appl. No. 12/665,002, filed Dec. 22, 2009, entitled "Method for Combining Transfer Function with Predetermined Key Creation", published as 20100182570 A1 Jul. 22, 2010, P76.
U.S. Appl. No. 12/592,331, filed Nov. 23, 2009, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 20100077220 A1 Mar. 25, 2010, P77.

U.S. Appl. No. 12/590,553, filed Nov. 10, 2009, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 20100077219 A1 Mar. 25, 2010, P78.
U.S. Appl. No. 12/590,681, filed Nov. 12, 2009, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 20100064140 A1 Mar. 11, 2010, P79.
U.S. Appl. No. 12/655,036, filed Dec. 22, 2009, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as 20100153734 A1 Jun. 17, 2010, P80.
U.S. Appl. No. 12/655,357, filed Dec. 22, 2009, entitled "Method And Device For Monitoring And Analyzing Signals", published as 20100106736 A1 Apr. 29, 2010, P81.
PCT Application No. PCT/US95/08159, filed Jun. 26, 1995, entitled, "Digital Information Commodities Exchange with Virtual Menuing", published as WO/1997/001892; Publication Date: Jan, 16, 1997, F24.
PCT Application No. PCT/US96/10257, filed Jun. 7, 1996, entitled "Steganographic Method and Device"—corresponding to—EPO Application No. 96919405.9, entitled "Steganographic Method and Device", published as WO/1996/042151; Publication Date: Dec. 27, 1996; F19.
PCT Application No. PCT/US97/00651, filed Jan. 16, 1997, entitled, "Method for Stega-Cipher Protection of Computer Code", published as WO/1997/026732; Publication Date: Jul. 24, 1997.
PCT Application No. PCT/US97/00652, filed Jan. 17, 1997, entitled, "Method for an Encrypted Digital Watermark", published as WO/1997/026733; Publication Date: Jul. 24, 1997.
PCT Application No. PCT/US97/11455, filed Jul. 2, 1997, entitled, "Optimization Methods for the Insertion, Protection and Detection of Digital Watermarks in Digitized Data", published as WO/1998/002864; Publication Date: Jan. 22, 1998.
PCT Application No. PCT/US99/07262, filed Apr. 2, 1999, entitled, "Multiple Transform Utilization and Applications for Secure Digital Watermarking", published as WO/1999/052271; Publication Date: Oct. 14, 1999.
PCT Application No. PCT/US00/06522, filed Mar. 14, 2000, entitled, "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as WO/2000/057643; Publication Date: Sep. 28, 2000.
PCT Application No. PCT/US00/18411, filed Jul. 5, 2000, entitled, "Copy Protection of Digital Data Combining Steganographic and Cryptographic Techniques".
PCT Application No. PCT/US00/33126, filed Dec. 7, 2000, entitled "Systems, Methods and Devices for Trusted Transactions", published as WO/2001/043026; Publication Date: Jun. 14, 2001.
EPO Divisional Patent Application No. 07112420.0, entitled "Steganographic Method and Device" corresponding to PCT Application No. PCT/US96/10257, published as WO/1996/042151, Dec. 27, 1996.
U.S. Appl. No. 60/222,023, filed Jul. 31, 2007 entitled "Method and apparatus for recognizing sound and signals in high noise and distortion".
U.S. Appl. No. 11/458,639, filed Jul. 19, 2006 entitled "Methods and Systems for Inserting Watermarks in Digital Signals", published as 20060251291 A1 Nov. 9, 2006, P82.
"Techniques for Data Hiding in Audio Files," by Morimoto, 1995.
Howe, Dennis Jul. 13, 1998 http://foldoc..org//steganography.
CSG, Computer Support Group and CSGNetwork.com 1973 http://www.csgnetwork.com/glossarys.html.
QuinStreet Inc. 2010 What is steganography?—A word definition from the Webopedia Computer Dictionary http://www.webopedia.com/terms/steganography.html.
Graham, Robert Aug. 21, 2000 "Hacking Lexicon" http://robertgraham.com/pubs/hacking-diet.html.
Farkex, Inc 2010 "Steganography definition of steganography in the Free Online Encyclopedia" http://encyclopedia2.Thefreedictionary.com/steganography.
Horowitz, et al., The Art of Eletronics. 2nd Ed., 1989, pp. 7.
Jimmy eat world ("futures"), Interscope Records, Pre-Release CD image, 2004, 1 page.
Aerosmith ("Just Push Play"), Pre-Release CD image, 2001, 1 page.
Phil Collins(Testify) Atlantic, Pre-Release CD image, 2002, 1 page.

* cited by examiner

METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of pending U.S. application Ser. No. 12/005,229, which is a continuation of U.S. patent application Ser. No. 09/657,181, now U.S. Pat. No. 7,346,472. The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties, as if fully stated herein.

This application claims the benefit of pending U.S. patent application Ser. No. 08/999,766, filed Jul. 23, 1997, entitled "Steganographic Method and Device" (issued as U.S. Pat. No. 7,568,100); pending U.S. patent application Ser. No. 08/772,222, filed Dec. 20, 1996, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,078,664); pending U.S. patent application Ser. No. 09/456,319, filed Dec. 8, 1999, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,853,726); pending U.S. patent application. Ser. No. 08/674,726, filed Jul. 2, 1996, entitled "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (issued as U.S. Pat. No. 7,362,775); pending U.S. patent application Ser. No. 09/545,589, filed Apr. 7, 2000, entitled "Method and System for Digital. Watermarking" (issued as U.S. Pat. No. 7,007,166); pending U.S. patent application Ser. No. 09/046,627, filed Mar. 24, 1998, entitled "Method for Combining Transfer Function with Predetermined Key Creation" (issued as U.S. Pat. No. 6,598,162); pending U.S. patent application Ser. No. 09/053,628, filed Apr. 2, 1998, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking" (issued as U.S. Pat. No. 6,205,249); pending U.S. patent application Ser. No. 09/281,279, filed Mar. 30, 1999, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data (issued as U.S. Pat. No. 6,522,767)"; U.S. patent application Ser. No. 09,594,719, filed Jun. 16, 2000, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems" (which is a continuation-in-part of PCT application No. PCT/US00/06522, filed Mar. 14, 2000, which PCT application claimed priority to U.S. Provisional Application No. 60/125,990, filed Mar. 24, 1999) (issued as U.S. Pat. No. 7,123,718); pending U.S. Application No. 60/169,274, filed Dec. 7, 1999, entitled "Systems, Methods And Devices For Trusted Transactions" (issued as U.S. Pat. No. 7,159,116); and PCT Application No. PCT/US00/21189, filed Aug. 4, 2000 (which claims priority to U.S. patent application Ser. No. 60/147,134, filed Aug. 4, 1999, and to U.S. patent application No. 60/213,489, filed. Jun. 23, 2000, both of which are entitled, "A Secure Personal Content Server") (issued as U.S. Pat. No. 7,475,246). The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties, as if fully stated herein.

In addition, this application hereby incorporates by reference, as if fully stated herein, the total disclosures of U.S. Pat. No. 5,613,004 "Steganographic Method and Device"; U.S. Pat. No. 5,745,569 "Method for Stega-Cipher Protection of Computer Code"; and U.S. Pat. No. 5,889,868 "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data."

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to the monitoring and analysis of digital information. A method and device are described which relate to signal recognition to enhance identification and monitoring activities.

2. Description of the Related Art

Many methods and protocols are known for transmitting data in digital form for multimedia applications (including computer applications delivered over public networks such as the internet or World Wide Web ("WWW"). These methods may include protocols for the compression of data, such that it may more readily and quickly be delivered over limited bandwidth data lines. Among standard protocols for data compression of digital files may be mentioned the MPEG compression standards for audio and video digital compression, promulgated by the Moving Picture Experts Group. Numerous standard reference works and patents discuss such compression and transmission standards for digitized information.

Digital watermarks help to authenticate the content of digitized multimedia information, and can also discourage piracy. Because piracy is clearly a disincentive to the digital distribution of copyrighted content, establishment of responsibility for copies and derivative copies of such works is invaluable. In considering the various forms of multimedia content, whether "master," stereo, NTSC video, audio tape or compact disc, tolerance of quality will vary with individuals and affect the underlying commercial and aesthetic value of the content. It is desirable to tie copyrights, ownership rights, purchaser information or some combination of these and related data into the content in such a manner that the content must undergo damage, and therefore reduction of its value, with subsequent, unauthorized distribution, commercial or otherwise. Digital watermarks address many of these concerns. A general discussion of digital watermarking as it has been applied in the art may be found in U.S. Pat. No. 5,687,236 (whose specification is incorporated in whole herein by reference).

Further applications of basic digital watermarking functionality have also been developed. Examples of such applications are shown in U.S. Pat. No. 5,889,868 (whose specification is incorporated in whole herein by reference). Such applications have been drawn, for instance, to implementations of digital watermarks that were deemed most suited to particular transmissions, or particular distribution and storage mediums, given the nature of digitally sampled audio, video, and other multimedia works. There have also been developed techniques for adapting watermark application parameters to the individual characteristics of a given digital sample stream, and for implementation of digital watermarks that are feature-based—i.e., a system in which watermark information is not carried in individual samples, but is carried in the relationships between multiple samples, such as in a waveform shape. For instance, natural extensions may be added to digital watermarks that may also separate frequencies (color or audio), channels in 3D while utilizing discreteness in feature-based encoding only known to those with pseudo-random keys (i.e., cryptographic keys) or possibly tools to access such information, which may one day exist on a quantum level.

A matter of general weakness in digital watermark technology relates directly to the manner of implementation of the watermark. Many approaches to digital watermarking leave detection and decode control with the implementing party of the digital watermark, not the creator of the work to be pro-

tected. This weakness removes proper economic incentives for improvement of the technology. One specific form of exploitation mostly regards efforts to obscure subsequent watermark detection. Others regard successful over encoding using the same watermarking process at a subsequent time. Yet another way to perform secure digital watermark implementation is through "key-based" approaches.

SUMMARY OF THE INVENTION

A method for monitoring and analyzing at least one signal is disclosed, which method comprises the steps of: receiving at least one reference signal to be monitored; creating an abstract of the at least one reference signal; storing the abstract of the at least one reference signal in a reference database; receiving at least one query signal to be analyzed; creating an abstract of the at least one query signal; and comparing the abstract of the at least one query signal to the abstract of the at least one reference signal to determine if the abstract of the at least one query signal matches the abstract of the at least one reference signal.

A method for monitoring a plurality of reference signals is also disclosed, which method comprises the steps of: creating an abstract for each one of a plurality of reference signals; storing each of the abstracts in a reference database; receiving at least one query signal to be analyzed; creating an abstract of each at least one query signal; locating an abstract in the reference database that matches the abstract of each at least one query signal; and recording the identify of the reference signal whose abstract matched the abstract of each at least one query signal.

A computerized system for monitoring and analyzing at least one signal is also disclosed, which system comprises: a processor for creating an abstract of a signal using selectable criteria; a first input for receiving at least one reference signal to be monitored, the first input being coupled to the processor such that the processor may generate an abstract for each reference signal input to the processor; a reference database, coupled to the processor, for storing abstracts of each at least one reference signal; a second input for receiving at least one query signal to be analyzed, the second input being coupled to the processor such that the processor may generate an abstract for each query signal; and a comparing device, coupled to the reference database and to the second input, for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

Further, an electronic system for monitoring and analyzing at least one signal is disclosed, which system comprises: a first input for receiving at least one reference signal to be monitored, a first processor for creating an abstract of each reference signal input to the first processor through the first input; a second input for receiving at least one query signal to be analyzed, a second processor for creating an abstract of each query signal; a reference database for storing abstracts of each at least one reference signal; and a comparing device for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

DETAILED DESCRIPTION OF THE INVENTION

While there are many approaches to data reduction that can be utilized, a primary concern is the ability to reduce the digital signal in such a manner as to retain a "perceptual relationship" between the original signal and its data reduced version. This relationship may either be mathematically discernible or a result of market-dictated needs. The purpose is to afford a more consistent means for classifying signals than proprietary, related text-based approaches. A simple analogy is the way in which a forensic investigator uses a sketch artist to assist in determining the identity of a human.

In one embodiment of the invention, the abstract of a signal may be generated by the following steps: 1) analyze the characteristics of each signal in a group of audible/perceptible variations for the same signal (e.g., analyze each of five versions of the same song—which versions may have the same lyrics and music but which are sung by different artists); and 2) select those characteristics which achieve or remain relatively constant (or in other words, which have minimum variation) for each of the signals in the group. Optionally, the null case may be defined using those characteristics which are common to each member of the group of versions.

Lossless and lossy compression schemes are appropriate candidates for data reduction technologies, as are those subset of approaches that are based on perceptual models, such as AAC, MP3, TwinVQ, JPEG, GIF, MPEG, etc. Where spectral transforms fail to assist in greater data reduction of the signal, other signal characteristics can be identified as candidates for further data reduction. Linear predictive coding (LPC), z-transform analysis, root mean square (rms), signal to peak, may be appropriate tools to measure signal characteristics, but other approaches or combinations of signal characteristic analysis are contemplated. While such signal characteristics may assist in determining particular applications of the present invention, a generalized approach to signal recognition is necessary to optimize the deployment and use of the present invention.

Increasingly, valuable information is being created and stored in digital form. For example, music, photographs and motion pictures can all be stored and transmitted as a series of binary digits—1's and 0's. Digital techniques permit the original information to be duplicated repeatedly with perfect or near perfect accuracy, and each copy is perceived by viewers or listeners as indistinguishable from the original signal. Unfortunately, digital techniques also permit the information to be easily copied without the owner's permission. While digital representations of analog waveforms may be analyzed by perceptually-based or perceptually-limited analysis it is usually costly and time-consuming to model the processes of the highly effective ability of humans to identify and recognize a signal. In those applications where analog signals require analysis, the cost of digitizing the analog signal is minimal when compared to the benefits of increased accuracy and speed of signal analysis and monitoring when the processes contemplated by this invention are utilized.

The present invention relates to identification of digitally-sampled information, such as images, audio and video. Traditional methods of identification and monitoring of those signals do not rely on "perceptual quality," but rather upon a separate and additional signal. Within this application, such signals will be called "additive signals" as they provide information about the original images, audio or video, but such information is in addition to the original signal. One traditional, text-based additive signal is title and author information. The title and author, for example, is information about a book, but it is in addition to the text of the book. If a book is being duplicated digitally, the title and author could provide one means of monitoring the number of times the text is being duplicated, for example, through an Internet download. The present invention, however, is directed to the identification of a digital signal—whether text, audio, or video—using only the digital signal itself and then monitoring the number of

times the signal is duplicated. Reliance on an additive signal has many shortcomings. For example, first, someone must incorporate the additive signal within the digital data being transmitted, for example, by concatenation or through an embedding process. Such an additive signal, however, can be easily identified and removed by one who wants to utilize the original signal without paying for its usage. If the original signal itself is used to identify the content, an unauthorized user could not avoid payment of a royalty simply by removing the additive signal—because there is no additive signal to remove. Hence, the present invention avoids a major disadvantage of the prior art.

One such additive signal that may be utilized is a digital watermark—which ideally cannot be removed without perceptually altering the original signal. A watermark may also be used as a monitoring signal (for example, by encoding an identifier that uniquely identifies the original digital signal into which the identifier is being embedded). A digital watermark used for monitoring is also an additive signal, and such a signal may make it difficult for the user who wants to duplicate a signal without paying a royalty—mainly by degrading the perceptual quality of the original signal if the watermark (and hence the additive monitoring signal) is removed. This is, however, is a different solution to the problem.

The present invention eliminates the need of any additive monitoring signal because the present invention utilizes the underlying content signal as the identifier itself. Nevertheless, the watermark may increase the value of monitoring techniques by increasing the integrity of the embedded data and by indicating tampering of either the original content signal or the monitoring signal. Moreover, the design of a watermarking embedding algorithm is closely related to the perceptibility of noise in any given signal and can represent an ideal subset of the original signal: the watermark bits are an inverse of the signal to the extent that lossy compression schemes, which can be used, for instance, to optimize a watermarking embedding scheme, can yield information about the extent to which a data signal can be compressed while holding steadfast to the design requirement that the compressed signal maintain its perceptual relationship with the original, uncompressed signal. By describing those bits that are candidates for imperceptible embedding of watermark bits, further data reduction may be applied on the candidate watermarks as an example of retaining a logical and perceptible relationship with the original uncompressed signal.

Of course, the present invention may be used in conjunction with watermarking technology (including the use of keys to accomplish secure digital watermarking), but watermarking is not necessary to practice the present invention. Keys for watermarking may have many forms, including: descriptions of the original carrier file formatting, mapping of embedded data (actually imperceptible changes made to the carrier signal and referenced to the predetermined key or key pairs), assisting in establishing the watermark message data integrity (by incorporation of special one way functions in the watermark message data or key), etc. Discussions of these systems in the patents and pending patent applications are incorporated by reference above. The "recognition" of a particular signal or an instance of its transmission, and its monitoring are operations that may be optimized through the use of digital watermark analysis.

A practical difference between the two approaches of using a separate, additive monitoring signal and using the original signal itself as the monitoring signal is control. If a separate signal is used for monitoring, then the originator of the text, audio or video signal being transmitted and the entity doing the monitoring have to agree as to the nature of the separate signal to be used for monitoring—otherwise, the entity doing the monitoring would not know where to look, for what to look, or how to interpret the monitoring signal once it was identified and detected. On the other hand, if the original signal is used itself as a monitoring signal, then no such agreement is necessary. Moreover, a more logical and self-sufficient relationship between the original and its data-reduced abstract enhances the transparency of any resulting monitoring efforts. The entity doing the monitoring is not looking for a separate, additive monitoring system, and further, need not have to interpret the content of the monitoring signal.

Monitoring implementations can be handled by robust watermark techniques (those techniques that are able to survive many signal manipulations but are not inherently "secure" for verification of a carrier signal absent a logically-related watermarking key) and forensic watermark techniques (which enable embedding of watermarks that are not able to survive perceptible alteration of the carrier signal and thus enable detection of tampering with the originally watermarked carrier signal). The techniques have obvious trade-offs between speed, performance and security of the embedded watermark data.

In other disclosures, we suggest improvements and implementations that relate to digital watermarks in particular and embedded signaling in general. A digital watermark may be used to "tag" content in a manner that is not humanly-perceptible, in order to ensure that the human perception of the signal quality is maintained. Watermarking, however, must inherently alter at least one data bit of the original signal to represent a minimal change from the original signal's "unwatermarked state." The changes may affect only a bit, at the very least, or be dependent on information hiding relating to signal characteristics, such as phase information, differences between digitized samples, root mean square (RMS) calculations, z-transform analysis, or similar signal characteristic category.

There are weaknesses in using digital watermark technology for monitoring purposes. One weakness relates directly to the way in which watermarks are implemented. Often, the persons responsible for encoding and decoding the digital watermark are not the creator of the valuable work to be protected. As such, the creator has no input on the placement of the monitoring signal within the valuable work being protected. Hence, if a user wishing to avoid payment of the royalty can find a way to decode or remove the watermark, or at least the monitoring signal embedded in the watermark, then the unauthorized user may successfully duplicate the signal with impunity. This could occur, for example, if either of the persons responsible for encoding or decoding were to have their security compromised such that the encoding or decoding algorithms were discovered by the unauthorized user.

With the present invention, no such disadvantages exist because the creator need not rely on anyone to insert a monitoring signal—as no such signal is necessary. Instead, the creator's work itself is used as the monitoring signal. Accordingly, the value in the signal will have a strong relationship with its recognizability.

By way of improving methods for efficient monitoring as well as effective confirmation of the identity of a digitally-sampled signal, the present invention describes useful methods for using digital signal processing for benchmarking a novel basis for differencing signals with binary data comparisons. These techniques may be complemented with perceptual techniques, but are intended to leverage the generally

decreasing cost of bandwidth and signal processing power in an age of increasing availability and exchange of digitized binary data.

So long as there exist computationally inexpensive ways of identifying an entire signal with some fractional representation or relationship with the original signal, or its perceptually observable representation, we envision methods for faster and more accurate auditing of signals as they are played, distributed or otherwise shared amongst providers (transmitters) and consumers (receivers). The ability to massively compress a signal to its essence—which is not strictly equivalent to "lossy" or "lossless" compression schemes or perceptual coding techniques, but designed to preserve some underlying "aesthetic quality" of the signal—represents a useful means for signal analysis in a wide variety of applications. The signal analysis, however, must maintain the ability to distinguish the perceptual quality of the signals being compared. For example, a method which analyzed a portion of a song by compressing it to a single line of lyrics fails to maintain the ability to distinguish the perceptual quality of the songs being compared. Specifically, for example, if the song "New York State of Mind" were compressed to the lyrics "I'm in a New York State of Mind," such a compression fails to maintain the ability to distinguish between the various recorded versions of the song, say, for example between Billy Joel's recording and Barbara Streisand's recording. Such a method is, therefore, incapable of providing accurate monitoring of the artist's recordings because it could not determine which of the two artists is deserving of a royalty—unless of course, there is a separate monitoring signal to provide the name of the artist or other information sufficient to distinguish the two versions. The present invention, however, aims to maintain some level of perceptual quality of the signals being compared and would deem such a compression to be excessive.

This analogy can be made clearer if it is understood that there are a large number of approaches to compressing a signal to, say, $1/10{,}000^{th}$ of its original size, not for maintaining its signal quality to ensure computational ease for commercial quality distribution, but to assist in identification, analysis or monitoring of the signal. Most compression is either lossy or lossless and is designed with psychoacoustic or psychovisual parameters. That is to say, the signal is compressed to retain what is "humanly-perceptible." As long as the compression successfully mimics human perception, data space may be saved when the compressed file is compared to the uncompressed or original file. While psychoacoustic and psychovisual compression has some relevance to the present invention, additional data reduction or massive compression is anticipated by the present invention. It is anticipated that the original signal may be compressed to create a realistic or self-similar representation of the original signal, so that the compressed signal can be referenced at a subsequent time as unique binary data that has computational relevance to the original signal. Depending on the application, general data reduction of the original signal can be as simple as massive compression or may relate to the watermark encoding envelope parameter (those bits which a watermarking encoding algorithm deem as candidate bits for mapping independent data or those bits deemed imperceptible to human senses but detectable to a watermark detection algorithm). In this manner, certain media which are commonly known by signal characteristics, a painting, a song, a TV commercial, a dialect, etc., may be analyzed more accurately, and perhaps, more efficiently than a text-based descriptor of the signal. So long as the sender and receiver agree that the data representation is accurate, even insofar as the data-reduction technique has logical relationships with the perceptibility of the original signal, as they must with commonly agreed to text descriptors, no independent cataloging is necessary.

The present invention generally contemplates a signal recognition system that has at least five elements. The actual number of elements may vary depending on the number of domains in which a signal resides (for example, audio is at least one domain while visual carriers are at least two dimensional). The present invention contemplates that the number of elements will be sufficient to effectively and efficiently meet the demands of various classes of signal recognition. The design of the signal recognition that may be used with data reduction is better understood in the context of the general requirements of a pattern or signal recognition system.

The first element is the reference database, which contains information about a plurality of potential signals that will be monitored. In one form, the reference database would contain digital copies of original works of art as they are recorded by the various artists, for example, contain digital copies of all songs that will be played by a particular radio station. In another form, the reference database would contain not perfect digital copies of original works of art, but digital copies of abstracted works of art, for example, contain digital copies of all songs that have been preprocessed such that the copies represent the perceptual characteristics of the original songs. In another form, the reference database would contain digital copies of processed data files, which files represent works of art that have been preprocessed in such a fashion as to identify those perceptual differences that can differentiate one version of a work of art from another version of the same work of art, such as two or more versions of the same song, but by different artists. These examples have obvious application to visually communicated works such as images, trademarks or photographs, and video as well.

The second element is the object locator, which is able to segment a portion of a signal being monitored for analysis (i.e., the "monitored signal"). The segmented portion is also referred to as an "object." As such, the signal being monitored may be thought of comprising a set of objects. A song recording, for example, can be thought of as having a multitude of objects. The objects need not be of uniform length, size, or content, but merely be a sample of the signal being monitored. Visually communicated informational signals have related objects; color and size are examples.

The third element is the feature selector, which is able to analyze a selected object and identify perceptual features of the object that can be used to uniquely describe the selected object. Ideally, the feature selector can identify all, or nearly all, of the perceptual qualities of the object that differentiate it from a similarly selected object of other signals. Simply, a feature selector has a direct relationship with the perceptibility of features commonly observed. Counterfeiting is an activity which specifically seeks out features to misrepresent the authenticity of any given object. Highly granular, and arguably successful, counterfeiting is typically sought for objects that are easily recognizable and valuable, for example, currency, stamps, and trademarked or copyrighted works and objects that have value to a body politic.

The fourth element is the comparing device which is able to compare the selected object using the features selected by the feature selector to the plurality of signals in the reference database to identify which of the signals matches the monitored signal. Depending upon how the information of the plurality of signals is stored in the reference database and depending upon the available computational capacity (e.g., speed and efficiency), the exact nature of the comparison will vary. For example, the comparing device may compare the selected object directly to the signal information stored in the

database. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector and then compare the selected object to the processed signal information. Alternatively, the comparing device may need to process the selected object using input from the feature selector and then compare the processed selected object to the signal information. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector, process the selected object using input from the feature selector, and then compare the processed selected object to the processed signal information.

The fifth element is the recorder which records information about the number of times a given signal is analyzed and detected. The recorder may comprise a database which keeps track of the number of times a song, image, or a movie has been played, or may generate a serial output which can be subsequently processed to determine the total number of times various signals have been detected.

Other elements may be added to the system or incorporated into the five elements identified above. For example, an error handler may be incorporated into the comparing device. If the comparing device identifies multiple signals which appear to contain the object being sought for analysis or monitoring, the error handler may offer further processing in order to identify additional qualities or features in the selected object such that only one of the set of captured signals is found to contain the further analyzed selected object that actually conforms with the object thought to have been transmitted or distributed.

Moreover, one or more of the five identified elements may be implemented with software that runs on the same processor, or which uses multiple processors. In addition, the elements may incorporate dynamic approaches that utilize stochastic, heuristic, or experience-based adjustments to refine the signal analysis being conducted within the system, including, for example, the signal analyses being performed within the feature selector and the comparing device. This additional analyses may be viewed as filters that are designed to meet the expectations of accuracy or speed for any intended application.

Since maintenance of original signal quality is not required by the present invention, increased efficiencies in processing and identification of signals can be achieved. The present invention concerns itself with perceptible relationships only to the extent that efficiencies can be achieved both in accuracy and speed with enabling logical relationships between an original signal and its abstract.

The challenge is to maximize the ability to sufficiently compress a signal to both retain its relationship with the original signal while reducing the data overhead to enable more efficient analysis, archiving and monitoring of these signals. In some cases, data reduction alone will not suffice: the sender and receiver must agree to the accuracy of the recognition. In other cases, agreement will actually depend on a third party who authored or created the signal in question. A digitized signal may have parameters to assist in establishing more accurate identification, for example, a "signal abstract" which naturally, or by agreement with the creator, the copyright owner or other interested parties, can be used to describe the original signal. By utilizing less than the original signal, a computationally inexpensive means of identification can be used. As long as a realistic set of conditions can be arrived at governing the relationship between a signal and its data reduced abstract, increases in effective monitoring and transparency of information data flow across communications channels is likely to result. This feature is significant in that it represents an improvement over how a digitally-sampled signal can be cataloged and identified, though the use of a means that is specifically selected based upon the strengths of a general computing device and the economic needs of a particular market for the digitized information data being monitored. The additional benefit is a more open means to uniformly catalog, analyze, and monitor signals. As well, such benefits can exist for third parties, who have a significant interest in the signal but are not the sender or receiver of said information.

As a general improvement over the art, the present invention incorporates what could best be described as "computer-acoustic" and "computer-visual" modeling, where the signal abstracts are created using data reduction techniques to determine the smallest amount of data, at least a single bit, which can represent and differentiate two digitized signal representations for a given predefined signal set. Each of such representations must have at least a one bit difference with all other members of the database to differentiate each such representation from the others in the database. The predefined signal set is the object being analyzed. The signal identifier/detector should receive its parameters from a database engine. The engine will identify those characteristics (for example, the differences) that can be used to distinguish one digital signal from all other digital signals that are stored in its collection. For those digital signals or objects which are seemingly identical, except[ing] that the signal may have different performance or utilization in the newly created object, benefits over additive or text-based identifiers are achieved. Additionally, decisions regarding the success or failure of an accurate detection of any given object may be flexibly implemented or changed to reflect market-based demands of the engine. Appropriate examples are songs or works or art which have been sampled or reproduced by others who are not the original creator.

In some cases, the engine will also consider the NULL case for a generalized item not in its database, or perhaps in situations where data objects may have collisions. For some applications, the NULL case is not necessary, thus making the whole system faster. For instance, databases which have fewer repetitions of objects or those systems which are intended to recognize signals with time constraints or capture all data objects. Greater efficiency in processing a relational database can be obtained because the rules for comparison are selected for the maximum efficiency of the processing hardware and/or software, whether or not the processing is based on psychoacoustic or psychovisual models. The benefits of massive data reduction, flexibility in constructing appropriate signal recognition protocols and incorporation of cryptographic techniques to further add accuracy and confidence in the system are clearly improvements over the art. For example, where the data reduced abstract needs to have further uniqueness, a hash or signature may be required. And for objects which have further uniqueness requirements, two identical instances of the object could be made unique with cryptographic techniques.

Accuracy in processing and identification may be increased by using one or more of the following fidelity evaluation functions:

1) RMS (root mean square). For example, a RMS function may be used to assist in determining the distance between data based on mathematically determinable Euclidean distance between the beginning and end data points (bits) of a particular signal carrier.

2) Frequency weighted RMS. For example, different weights may be applied to different frequency components of the carrier signal before using RMS. This selective weighting can assist in further distinguishing the distance between

beginning and end points of the signal carrier (at a given point in time, described as bandwidth, or the number of total bits that can be transmitted per second) and may be considered to be the mathematical equivalent of passing a carrier signal difference through a data filter and figuring the average power in the output carrier.

3) Absolute error criteria, including particularly the NULL set (described above) The NULL may be utilized in two significant cases: First, in instances where the recognized, signal appears to be an identified object which is inaccurately attributed or identified to an object not handled by the database of objects; and second, where a collision of data occurs. For instance, if an artist releases a second performance of a previously recorded song, and the two performances are so similar that their differences are almost imperceptible, then the previously selected criteria may not be able to differentiate the two recordings. Hence, the database must be "recalibrated" to be able to differentiate these two versions. Similarly, if the system identifies not one, but two or more, matches for a particular search, then the database may need "recalibration" to further differentiate the two objects stored in the database.

4) Cognitive Identification. For example, the present invention may use an experience-based analysis within a recognition engine. Once such analysis may involve mathematically determining a spectral transform or its equivalent of the carrier signal. A spectral transform enables signal processing and should maintain, for certain applications, some cognitive or perceptual relationship with the original analog waveform. As a novel feature to the present invention, additional classes may be subject to humanly-perceptible observation. For instance, an experience-based criteria which relates particularly to the envisioned or perceived accuracy of the data information object as it is used or applied in a particular market, product, or implementation. This may include a short 3 second segment of a commercially available and recognizable song which is used for commercials to enable recognition of the good or service being marketed. The complete song is marketed as a separately valued object from the use of a discrete segment of the song (that may be used for promotion or marketing—for the complete song or for an entirely different good or service). To the extent that an owner of the song in question is able to further enable value through the licensing or agreement for use of a segment of the original signal, cognitive identification is a form of filtering to enable differentiations between different and intended uses of the same or subset of the same signal (object). The implementation relating specifically, as disclosed herein, to the predetermined identification or recognition means and/or any specified relationship with subsequent use of the identification means can be used to create a history as to how often a particular signal is misidentified, which history can then be used to optimize identification of that signal in the future. The difference between use of an excerpt of the song to promote a separate and distinct good or service and use of the excerpt to promote recognition of the song itself (for example, by the artist to sell copies of the song) relates informationally to a decision based on recognized and approved use of the song. Both the song and applications of the song in its entirety or as a subset are typically based on agreement by the creator and the sender who seeks to utilize the work. Trust in the means for identification, which can be weighted in the present invention (for example, by adjusting bit-addressable information), is an important factor in adjusting the monitoring or recognition features of the object or carrier signal, and by using any misidentification information, (including any experience-based or heuristic information), additional features of the monitored signal can be used to improve the performance of the monitoring system envisioned herein. The issue of central concern with cognitive identification is a greater understanding of the parameters by which any given object is to be analyzed. To the extent that a creator chooses varying and separate application of his object, those applications having a cognitive difference in a signal recognition sense (e.g., the whole or an excerpt), the system contemplated herein includes rules for governing the application of bit-addressable information to increase the accuracy of the database.

5) Finally, the predetermined parameters that are associated with a discrete case for any given object will have a significant impact upon the ability to accurately process and identify the signals. For example, if a song is transmitted over a FM carrier, then one skilled in the art will appreciate that the FM signal has a predetermined bandwidth which is different from the bandwidth of the original recording, and different even from song when played on an AM carrier, and different yet from a song played using an 8-bit Internet broadcast. Recognition of these differences, however, will permit the selection of an identification means which can be optimized for monitoring a FM broadcasted signal. In other words, the discreteness intended by the sender is limited and directed by the fidelity of the transmission means. Objects may be cataloged and assessing with the understanding that all monitoring will occur using a specific transmission fidelity. For example, a database may be optimized with the understanding that only AM broadcast signals will be monitored. For maximum efficiency, different data bases may be created for different transmission channels, e.g., AM broadcasts, FM broadcasts, Internet broadcasts, etc.

For more information on increasing efficiencies for information systems, see *The Mathematical Theory of Communication* (1948), by Shannon.

Because bandwidth (which in the digital domain is equated to the total number of bits that can be transmitted in a fixed period of time) is a limited resource which places limitations upon transmission capacity and information coding schemes, the importance of monitoring for information objects transmitted over any given channel must take into consideration the nature and utilization of a given channel. The supply and demand of bandwidth will have a dramatic impact on the transmission, and ultimately, upon the decision to monitor and recognize signals. A discussion of this is found in an application by the inventor under U.S. patent application Ser. No. 08/674,726 (which issued Apr. 22, 2008 as U.S. Pat. No. 7,362,775) "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (which application is incorporated herein by reference as if fully setforth herein).

If a filter is to be used in connection with the recognition or monitoring engine, it may be desirable for the filter to anticipate and take into consideration the following factors, which affect the economics of the transmission as they relate to triggers for payment and/or relate to events requiring audits of the objects which are being transmitted: 1) time of transmission (i.e., the point in time when the transmission occurred), including whether the transmission is of a live performance); 2) location of transmission (e.g., what channel was used for transmission, which usually determines the associated cost for usage of the transmission channel); 3) the point of origination of the transmission (which may be the same for a signal carrier over many distinct channels); and 4) pre-existence of the information carrier signal (pre-recorded or newly created information carrier signal, which may require differentiation in certain markets or instances).

In the case of predetermined carrier signals (those which have been recorded and stored for subsequent use), "positional information carrier signals" are contemplated by this invention, namely, perceptual differences between the seemingly "same" information carrier that can be recognized as consumers of information seek different versions or quality levels of the same carrier signal. Perceptual differences exist between a song and its reproduction from a CD, an AM radio, and an Internet broadcast. To the extent that the creator or consumer of the signal can define a difference in any of the four criteria above, means can be derived (and programmed for selectability) to recognize and distinguish these differences. It is, however, quite possible that the ability to monitor carrier signal transmission with these factors will increase the variety and richness of available carrier signals to existing communications channels. The differentiation between an absolute case for transmission of an object, which is a time dependent event, for instance a live or real time broadcast, versus the relative case, which is prerecorded or stored for transmission at a later point in time, creates recognizable differences for signal monitoring.

The monitoring and analysis contemplated by this invention may have a variety of purposes, including, for example, the following: to determine the number of times a song is broadcast on a particular radio broadcast or Internet site; to control security though a voice-activated security system; and to identify associations between a beginner's drawing and those of great artists (for example to draw comparisons between technique, compositions, or color schemes). None of these examples could be achieved with any significant degree of accuracy using a text-based analysis. Additionally, strictly text-based systems fail to fully capture the inherent value of the data recognition or monitoring information itself.

SAMPLE EMBODIMENTS

Sample Embodiment 1

A database of audio signals (e.g., songs) is stored or maintained by a radio station or Internet streaming company, who may select a subset of the songs are stored so that the subset may be later broadcast to listeners. The subset, for example, may comprise a sufficient number of songs to fill 24 hours of music programming (between 300 or 500 songs). Traditionally, monitoring is accomplished by embedding some identifier into the signal, or affixing the identifier to the signal, for later analysis and determination of royalty payments. Most of the traditional analysis is performed by actual persons who use play lists and other statistical approximations of audio play, including for example, data obtained through the manual (i.e., by persons) monitoring of a statistically significant sample of stations and transmission times so that an extrapolation may be made to a larger number of comparable markets.

The present invention creates a second database from the first database, wherein each of the stored audio signals in the first database is data reduced in a manner that is not likely to reflect the human perceptual quality of the signal, meaning that a significantly data-reduced signal is not likely to be played back and recognized as the original signal. As a result of the data reduction, the size of the second database (as measured in digital terms) is much smaller than the size of the first database, and is determined by the rate of compression. If, for example, if 24 hours worth of audio signals are compressed at a 10,000:1 compression rate, the reduced data could occupy a little more than 1 megabyte of data. With such a large compression rate, the data to be compared and/or analyzed may become computationally small such that computational speed and efficiency are significantly improved.

With greater compression rates, it is anticipated that similarity may exist between the data compressed abstractions of different analog signals (e.g., recordings by two different artists of the same song). The present invention contemplates the use of bit-addressable differences to distinguish between such cases. In applications where the data to be analyzed has higher value in some predetermined sense, cryptographic protocols, such as a hash or digital signature, can be used to distinguish such close cases.

In a preferred embodiment, the present invention may utilize a centralized database where copies of new recordings may be deposited to ensure that copyright owners, who authorize transmission or use of their recordings by others, can independently verify that the object is correctly monitored. The rules for the creator himself to enter his work would differ from a universally recognized number assigned by an independent authority (say, ISRC, ISBN for recordings and books respectively). Those skilled in the art of algorithmic information theory (AIT) can recognize that it is now possible to describe optimized use of binary data for content and functionality. The differences between objects must relate to decisions made by the user of the data, introducing subjective or cognitive decisions to the design of the contemplated invention as described above. To the extent that objects can have an optimized data size when compared with other objects for any given set of objects, the algorithms for data reduction would have predetermined flexibility directly related to computational efficiency and the set of objects to be monitored. The flexibility in having transparent determination of unique signal abstracts, as opposed to independent third party assignment, is likely to increase confidence in the monitoring effort by the owners of the original signals themselves. The prior art allows for no such transparency to the copyright creators.

Sample Embodiment 2

Another embodiment of the invention relates to visual images, which of course, involve at least two dimensions.

Similar to the goals of a psychoacoustic model, a psychovisual model attempts to represent a visual image with less data, and yet preserve those perceptual qualities that permit a human to recognize the original visual image. Using the very same techniques described above in connection with an audio signal, signal monitoring of visual images may be implemented.

One such application for monitoring and analyzing visual images involves a desire to find works of other artists that relate to a particular theme. For example, finding paintings of sunsets or sunrises. A traditional approach might involve a textual search involving a database wherein the works of other artists have been described in writing. The present invention, however, involves the scanning of an image involving a sun, compressing the data to its essential characteristics (i.e., those perceptual characteristics related to the sun) and then finding matches in a database of other visual images (stored as compressed or even uncompressed data). By studying the work of other artists using such techniques, a novice, for example, could learn much by comparing the presentations of a common theme by different artists.

Another useful application involving this type of monitoring and analyzing is the identification of photographs of potential suspects whose identity matches the sketch of a police artist.

Note that combinations of the monitoring techniques discussed above can be used for audio-visual monitoring, such

as video-transmission by a television station or cable station. The techniques would have to compensate, for example, for a cable station that is broadcasting a audio channel unaccompanied by video.

Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The specification and examples should be considered exemplary only with the true scope and spirit of the invention indicated by the following claims. As will be easily understood by those of ordinary skill in the art, variations and modifications of each of the disclosed embodiments can be easily made within the scope of this invention as defined by the following claims.

What is claimed:

1. A system for identifying at least one reference signal comprising:

a first input that receives at least one reference signal to be identified;

a first processor that creates an abstract of each reference signal input to said first processor through said first input wherein the abstract comprises signal characteristic parameters configured to differentiate between versions of said reference signal;

at least one reference database for storing at least one abstract;

a receiver that receives at least one query signal;

a second processor that creates an abstract of said query signal received by said receiver, based on the parameters; and

a comparing device that compares the created query signal abstract to the reference signal abstracts in the at least one database, each abstract in the at least one reference database corresponding to a version of a reference signal, to determine whether the query signal abstract matches any of the stored at least one abstract in the at least one reference database.

2. The system of claim **1**, further comprising: a controller that enables authorized transmission or use of the corresponding version of the reference signal based on whether a match was determined by the comparing device.

3. The system of claim **1**, wherein the reference database is created by at least one of a music company, a movie studio, an image archive, an owner of a general computing device, a user of the reference signal, an interne service provider, an information technology company, a body politic, a telecommunications company and combinations thereof.

4. The system of claim **1**, wherein the reference signals comprise at least one of images, audio, video, and combinations thereof.

5. The system of claim **1**, wherein the stored abstracts are derived from one of a cognitive feature or a perceptible characteristic of the associated reference signals.

6. The system of claim **1**, furthering comprising a security controller to apply a cryptographic protocol to at least one created abstract, at least one database abstract or both at least one created abstract and at least one database abstract.

7. The system of claim **1**, wherein each of the stored abstracts comprise information configured to differentiate variations of each referenced corresponding signal.

8. The system of claim **1**, further comprising a storage medium for storing information associated with the comparing device to store information to enable at least one of a re-calibration of the database and a heuristic-based adjustment of the database.

9. The system of claim **1**, further comprising a storage medium for storing information associated with the comparing device to store information to enable a computational

efficiency adjustment of the database, an adjustment for database collisions and/or null cases, a change to the recognition or use parameters governing the database and combinations thereof.

10. The system of claim **1**, further comprising applying one of a relatedness index or measure of similarity to generate uniquely identifiable information to determine authorization by the comparing device.

11. A system for analyzing and identifying at least one reference signal, comprising: a first input for receiving at least one reference signal to be identified, a first processor for creating an abstract of each reference signal received based on perceptual characteristics representative of parameters to differentiate between versions of the reference signal; a reference database for storing abstracts of each reference signal received in a database; a second input for receiving at least one query signal to be identified, a second processor for creating an abstract of the received query signal based on the parameters; and a comparing device for comparing an abstract of said received query signal to the abstracts stored in the database to determine if the abstract of said received query signal is related to any of the stored abstracts.

12. The system of claim **11**, wherein said database is independently accessible.

13. The system of claim **11**, wherein said received query signal is independently stored.

14. The system of claim **11**, wherein the parameters used by the comparing device to compare a received query signal abstract with a stored reference signal abstract are adjustable.

15. The system of claim **11**, wherein the stored abstracts comprise a self-similar representation of at least one reference signal.

16. The system of claim **11**, wherein at least two of the stored abstracts comprise information corresponding to two versions of at least one reference signal.

17. The system of claim **11**, wherein at least one abstract comprises data describing a portion of the characteristics of its associated reference signal.

18. The system of claim **17**, wherein the characteristics of the reference signal being described comprise at least one of a perceptible characteristic, a cognitive characteristic, a subjective characteristic, a perceptual quality, a recognizable characteristic or combinations thereof.

19. The system of claim **11**, wherein a stored abstract comprises data unique to a variation of its corresponding reference signal.

20. The system of claim **11**, wherein the system further comprises a security controller for applying a cryptographic protocol to the abstract of said reference signal, said query signal, or both said reference signal and said query signal.

21. The system of claim **20**, wherein the cryptographic protocol is one of at least a hash or digital signature and further comprising storing the hashed abstract and/or digitally signed abstract in the reference database.

22. The system of claim **11**, further comprising a transmitter for distributing at least one signal based on the comparison step.

23. The system of claim **22**, further comprising a processor for applying a watermarking technique to the at least one signal to be distributed.

24. A system for identifying a plurality of reference signals comprising:

a first input that receives a plurality of reference signals to be identified;

a first processor that creates an abstract for each of the plurality of reference signals input to said first processor through said first input wherein the abstract comprises

signal characteristic parameters configured to differentiate between versions of at least one reference signal; at least one reference database for storing the plurality of created abstracts; a receiver for receiving a query signal; a second processor that creates an abstract of said query signal received by said receiver, based on the parameters; and a comparing device that compares the created query signal abstract to the abstracts stored in the at least one database, to determine whether the query signal abstract matches any of the stored abstracts in the at least one reference database.

25. The system of claim **24**, wherein the first and second processors are the same processor.

26. The system of claim **24**, wherein the first and second processors are different processors.

27. A system for determining whether a query signal matches a reference signal, comprising:

a first processor configured to create a first version abstract of a first version of a reference signal input to said first processor;

wherein said first version abstract comprises signal characteristic parameters configured to differentiate said first version of said reference signal from a second version of said reference signal;

a reference database storing said first version abstract;

a device configured to determine whether said first version of said reference signal matches a query signal, by comparing a query signal abstract of said query signal to said first version abstract stored in said reference database.

28. A system for determining whether a query signal matches a reference signal, comprising:

a first processor configured to create a first version abstract of a first version of a reference signal input to said first processor, wherein said first processor is configured to create said first version abstract from said first version of said reference signal based upon perceptual characteristics of said first version of said reference signal, such that said first version abstract retains a perceptual relationship to said first version of said reference signal;

a reference database storing said first version abstract;

a second processor configured to create a query signal abstract from a query signal, wherein said second processor is configured to generate said query signal abstract from said query signal based upon perceptual characteristics of said query signal, such that said query signal abstract retains a perceptual relationship to said query signal; and

a device configured to determine whether a query signal matches said first version of said reference signal, by comparing, a query signal abstract that was generated based upon perceptual characteristics of said query signal, with said first version abstract stored in said reference database.

29. A system for determining whether a query signal matches any of a plurality of reference signal, comprising:

a first processor configured to create a plurality of reference signal abstracts for each one of a plurality of reference signals, wherein each one of said plurality of reference signal abstracts comprises signal characteristic parameters configured to differentiate between other versions of that one of said plurality of reference signals;

a reference database storing said plurality of reference signal abstracts;

a device configured to determine if a query signal matches any one plurality of reference signals by comparing a query signal abstract of said query signal with at least one abstract of said plurality of reference signal abstracts stored in said reference database.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,949,494 B2
APPLICATION NO. : 12/655357
DATED : May 24, 2011
INVENTOR(S) : Moskowitz

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1 line 14 reading:
This application claims the benefit of pending U.S. patent

should read:

This application is related to pending U.S. patent

Column 15 line 44 reading:

of the reference signal, an interne service provider, an infor-

should read:

of the reference signal, an internet service provider, an infor-

Signed and Sealed this
Thirtieth Day of August, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

US008214175B2

(12) **United States Patent**
Moskowitz et al.

(10) **Patent No.: US 8,214,175 B2**
(45) **Date of Patent: Jul. 3, 2012**

(54) **METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS**

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(63) Continuation of application No. 12/655,357, filed on Dec. 22, 2009, now Pat. No. 7,949,494, which is a continuation of application No. 12/005,229, filed on Dec. 26, 2007, now Pat. No. 7,660,700, which is a continuation of application No. 09/657,181, filed on Sep. 7, 2000, now Pat. No. 7,346,472.

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(58) **Field of Classification Search** 702/182; 704/201, 204, 211, 270, 219, 500, 503, 504; 341/155, 76, 61

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,947,825	A		3/1976	Cassada
3,984,624	A		10/1976	Waggener
3,986,624	A		10/1976	Cates, Jr. et al.
4,038,596	A		7/1977	Lee
4,200,770	A		4/1980	Hellman et al.
4,218,582	A		8/1980	Hellman et al.
4,339,134	A		7/1982	Macheel
4,390,898	A		6/1983	Bond et al.
4,405,829	A		9/1983	Rivest et al.
4,424,414	A		1/1984	Hellman et al.
4,528,588	A		7/1985	Lofberg
4,672,605	A		6/1987	Hustig et al.
4,748,668	A		5/1988	Shamir et al.
4,789,928	A		12/1988	Fujisaki
4,827,508	A		5/1989	Shear
4,876,617	A		10/1989	Best et al.
4,896,275	A		1/1990	Jackson
4,908,873	A		3/1990	Philibert et al.
4,939,515	A		7/1990	Adelson
4,969,204	A		11/1990	Jones et al.
4,972,471	A		11/1990	Gross et al.
4,977,594	A		12/1990	Shear
4,979,210	A		12/1990	Nagata et al.
4,980,782	A		12/1990	Ginkel
5,050,213	A		9/1991	Shear
5,073,925	A		12/1991	Nagata et al.
5,077,665	A		12/1991	Silverman et al.
5,111,530	A	*	5/1992	Kutaragi et al. 704/270
5,113,437	A		5/1992	Best et al.
5,136,581	A		8/1992	Muehrcke
5,136,646	A		8/1992	Haber et al.
5,136,647	A		8/1992	Haber et al.
5,142,576	A		8/1992	Nadan
5,161,210	A		11/1992	Druyvesteyn et al.
5,210,820	A		5/1993	Kenyon
5,243,423	A		9/1993	DeJean et al.
5,243,515	A		9/1993	Lee
5,287,407	A		2/1994	Holmes
5,319,735	A		6/1994	Preuss et al.
5,327,520	A	*	7/1994	Chen 704/219
5,341,429	A		8/1994	Stringer et al.
5,341,477	A		8/1994	Pitkin et al.
5,363,448	A		11/1994	Koopman et al.
5,365,586	A		11/1994	Indeck et al.
5,369,707	A		11/1994	Follendore, III
5,379,345	A		1/1995	Greenberg
5,394,324	A		2/1995	Clearwater

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0372601	6/1990

(Continued)

OTHER PUBLICATIONS

Jap. App. No. 2000-542907, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking"; which is a JP national stage of PCT/US1999/007262, published as WO/1999/052271, Oct. 14, 1999.
PCT Application No. PCT/US00/21189, filed Aug. 4, 2000, entitled, "A Secure Personal Content Server", Pub. No. WO/2001/018628 ; Publication Date Mar. 15, 2001.
EPO Application No. 96919405.9, entitled "Steganographic Method and Device"; published as EP0872073 (A2), Oct. 21, 1998.
Schneier, Bruce, Applied Cryptography, 2nd Ed., John Wiley & Sons, pp. 9-10, 1996.
Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 46, 1997.
1997, Merriam-Webster's Collegiate Dictionary, 10th Ed., Merriam Webster, Inc., p. 207.

(Continued)

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(57) **ABSTRACT**

A method and system for monitoring and analyzing at least one signal are disclosed. An abstract of at least one reference signal is generated and stored in a reference database. An abstract of a query signal to be analyzed is then generated so that the abstract of the query signal can be compared to the abstracts stored in the reference database for a match. The method and system may optionally be used to record information about the query signals, the number of matches recorded, and other useful information about the query signals. Moreover, the method by which abstracts are generated can be programmable based upon selectable criteria. The system can also be programmed with error control software so as to avoid the re-occurrence of a query signal that matches more than one signal stored in the reference database.

19 Claims, No Drawings

U.S. PATENT DOCUMENTS

5,398,285	A		3/1995	Borgelt et al.	
5,406,627	A		4/1995	Thompson et al.	
5,408,505	A		4/1995	Indeck et al.	
5,410,598	A		4/1995	Shear	
5,412,718	A		5/1995	Narasimhalv et al.	
5,418,713	A		5/1995	Allen	
5,428,606	A		6/1995	Moskowitz	
5,450,490	A		9/1995	Jensen et al.	
5,469,536	A		11/1995	Blank	
5,471,533	A		11/1995	Wang et al.	
5,478,990	A		12/1995	Montanari et al.	
5,479,210	A		12/1995	Cawley et al.	
5,487,168	A		1/1996	Geiner et al.	
5,493,677	A		2/1996	Balogh et al.	
5,497,419	A		3/1996	Hill	
5,506,795	A		4/1996	Yamakawa	
5,513,126	A		4/1996	Harkins et al.	
5,513,261	A		4/1996	Maher	
5,530,739	A		6/1996	Okada	
5,530,751	A		6/1996	Morris	
5,530,759	A		6/1996	Braudaway et al.	
5,539,735	A		7/1996	Moskowitz	
5,548,579	A		8/1996	Lebrun et al.	
5,568,570	A		10/1996	Rabbani	
5,579,124	A		11/1996	Aijala et al.	
5,581,703	A		12/1996	Baugher et al.	
5,583,488	A		12/1996	Sala et al.	
5,598,470	A		1/1997	Cooper et al.	
5,606,609	A		2/1997	Houser et al.	
5,613,004	A		3/1997	Cooperman et al.	
5,617,119	A		4/1997	Briggs et al.	
5,617,506	A	*	4/1997	Burk et al.	704/201
5,625,690	A		4/1997	Michel et al.	
5,629,980	A		5/1997	Stefik et al.	
5,633,932	A		5/1997	Davis et al.	
5,634,040	A		5/1997	Her et al.	
5,636,276	A		6/1997	Brugger	
5,636,292	A		6/1997	Rhoads	
5,640,569	A		6/1997	Miller et al.	
5,646,997	A		7/1997	Barton	
5,657,461	A		8/1997	Harkins et al.	
5,659,726	A		8/1997	Sandford, II et al.	
5,664,018	A		9/1997	Leighton	
5,673,316	A		9/1997	Auerbach et al.	
5,677,952	A		10/1997	Blakely et al.	
5,680,462	A		10/1997	Miller et al.	
5,687,236	A		11/1997	Moskowitz et al.	
5,689,587	A		11/1997	Bender et al.	
5,696,828	A		12/1997	Koopman, Jr.	
5,719,937	A		2/1998	Warren et al.	
5,721,788	A		2/1998	Powell et al.	
5,734,752	A		3/1998	Knox	
5,737,416	A		4/1998	Cooper et al.	
5,737,733	A		4/1998	Eller	
5,740,244	A		4/1998	Indeck et al.	
5,745,569	A		4/1998	Moskowitz et al.	
5,748,783	A		5/1998	Rhoads	
5,751,811	A		5/1998	Magnotti et al.	
5,754,697	A		5/1998	Fu et al.	
5,757,923	A		5/1998	Koopman, Jr.	
5,765,152	A		6/1998	Erickson	
5,768,396	A		6/1998	Sone	
5,774,452	A		6/1998	Wolosewicz	
5,781,184	A	*	7/1998	Wasserman et al.	348/571
5,790,677	A		8/1998	Fox et al.	
5,799,083	A		8/1998	Brothers et al.	
5,809,139	A		9/1998	Grirod et al.	
5,809,160	A		9/1998	Powell et al.	
5,818,818	A		10/1998	Soumiya	
5,822,432	A		10/1998	Moskowitz et al.	
5,828,325	A		10/1998	Wolosewicz et al.	
5,832,119	A		11/1998	Rhoads	
5,839,100	A	*	11/1998	Wegener	704/220
5,842,213	A		11/1998	Odom	
5,848,155	A		12/1998	Cox	
5,850,481	A		12/1998	Rhoads	
5,859,920	A		1/1999	Daly et al.	
5,860,099	A		1/1999	Milios et al.	
5,862,260	A		1/1999	Rhoads	
5,870,474	A		2/1999	Wasilewski et al.	
5,884,033	A		3/1999	Duvall et al.	
5,889,868	A		3/1999	Moskowitz et al.	
5,893,067	A		4/1999	Bender et al.	
5,894,521	A		4/1999	Conley	
5,901,178	A	*	5/1999	Lee et al.	375/240
5,903,721	A		5/1999	Sixtus	
5,905,800	A		5/1999	Moskowitz et al.	
5,905,975	A		5/1999	Ausubel	
5,912,972	A		6/1999	Barton	
5,915,027	A		6/1999	Cox et al.	
5,917,915	A		6/1999	Hirose	
5,918,223	A		6/1999	Blum	
5,920,900	A		7/1999	Poole et al.	
5,923,763	A		7/1999	Walker et al.	
5,930,369	A		7/1999	Cox et al.	
5,930,377	A		7/1999	Powell et al.	
5,940,134	A		8/1999	Wirtz	
5,943,422	A		8/1999	Van Wie et al.	
5,949,055	A		9/1999	Fleet	
5,963,909	A		10/1999	Warren et al.	
5,973,731	A		10/1999	Schwab	
5,974,141	A		10/1999	Saito	
5,991,426	A		11/1999	Cox et al.	
5,999,217	A		12/1999	Berners-Lee	
6,009,176	A		12/1999	Gennaro et al.	
6,029,126	A		2/2000	Malvar	
6,041,316	A		3/2000	Allen	
6,044,471	A		3/2000	Colvin	
6,049,838	A		4/2000	Miller et al.	
6,051,029	A		4/2000	Paterson et al.	
6,061,793	A		5/2000	Tewfik et al.	
6,067,622	A		5/2000	Moore	
6,069,914	A		5/2000	Cox	
6,078,664	A		6/2000	Moskowitz et al.	
6,081,251	A		6/2000	Sakai et al.	
6,081,587	A		6/2000	Reyes et al.	
6,081,597	A		6/2000	Hoffstein	
6,088,455	A		7/2000	Logan et al.	
6,131,162	A		10/2000	Yoshiura et al.	
6,141,753	A		10/2000	Zhao et al.	
6,141,754	A		10/2000	Choy	
6,148,333	A		11/2000	Guedalia	
6,154,571	A		11/2000	Cox et al.	
6,178,405	B1	*	1/2001	Ouyang et al.	704/500
6,192,138	B1		2/2001	Yamadaji	
6,199,058	B1		3/2001	Wong et al.	
6,205,249	B1		3/2001	Moskowitz	
6,208,745	B1		3/2001	Florenio et al.	
6,226,618	B1		5/2001	Downs	
6,230,268	B1		5/2001	Miwa et al.	
6,233,347	B1		5/2001	Chen et al.	
6,233,684	B1		5/2001	Stefik et al.	
6,240,121	B1		5/2001	Senoh	
6,263,313	B1		7/2001	Milstead et al.	
6,272,634	B1		8/2001	Tewfik et al.	
6,275,988	B1		8/2001	Nagashima et al.	
6,278,780	B1		8/2001	Shimada	
6,278,791	B1		8/2001	Honsinger et al.	
6,282,300	B1		8/2001	Bloom et al.	
6,282,650	B1		8/2001	Davis	
6,285,775	B1		9/2001	Wu et al.	
6,301,663	B1		10/2001	Kato et al.	
6,310,962	B1		10/2001	Chung et al.	
6,330,335	B1		12/2001	Rhoads	
6,330,672	B1		12/2001	Shur	
6,345,100	B1		2/2002	Levine	
6,351,765	B1		2/2002	Pietropaolo et al.	
6,363,483	B1		3/2002	Keshav	
6,373,892	B1		4/2002	Ichien et al.	
6,373,960	B1		4/2002	Conover et al.	
6,374,036	B1		4/2002	Ryan et al.	
6,377,625	B1		4/2002	Kim	
6,381,618	B1		4/2002	Jones et al.	
6,381,747	B1		4/2002	Wonfor et al.	
6,385,324	B1		5/2002	Koppen	
6,385,329	B1		5/2002	Sharma et al.	
6,385,596	B1		5/2002	Wiser	

6,389,538	B1	5/2002	Gruse et al.
6,405,203	B1	6/2002	Collart
6,415,041	B1	7/2002	Oami et al.
6,418,421	B1	7/2002	Hurtado
6,425,081	B1	7/2002	Iwamura
6,430,301	B1	8/2002	Petrovic
6,430,302	B2	8/2002	Rhoads
6,442,283	B1	8/2002	Tewfik et al.
6,446,211	B1	9/2002	Colvin
6,453,252	B1	9/2002	Laroche
6,457,058	B1	9/2002	Ullum et al.
6,463,468	B1	10/2002	Buch et al.
6,484,264	B1	11/2002	Colvin
6,493,457	B1	12/2002	Quackenbush
6,502,195	B1	12/2002	Colvin
6,522,767	B1	2/2003	Moskowitz et al.
6,522,769	B1	2/2003	Rhoads et al.
6,523,113	B1	2/2003	Wehrenberg
6,530,021	B1	3/2003	Epstein et al.
6,532,284	B2	3/2003	Walker et al.
6,539,475	B1	3/2003	Cox et al.
6,557,103	B1	4/2003	Boncelet, Jr. et al.
6,584,125	B1	6/2003	Katto
6,587,837	B1	7/2003	Spagna et al.
6,590,996	B1	7/2003	Reed
6,598,162	B1	7/2003	Moskowitz
6,606,393	B1	8/2003	Xie et al.
6,611,599	B2	8/2003	Natarajan
6,647,424	B1	11/2003	Pearson et al.
6,658,010	B1	12/2003	Enns et al.
6,665,489	B2	12/2003	Collart
6,668,246	B1	12/2003	Yeung et al.
6,668,325	B1	12/2003	Collberg et al.
6,674,858	B1	1/2004	Kimura
6,687,683	B1	2/2004	Harada et al.
6,725,372	B1	4/2004	Lewis et al.
6,754,822	B1	6/2004	Zhao
6,775,772	B1	8/2004	Binding et al.
6,784,354	B1	8/2004	Lu et al.
6,785,815	B1	8/2004	Serret-Avila et al.
6,785,825	B2	8/2004	Colvin
6,792,548	B2	9/2004	Colvin
6,792,549	B2	9/2004	Colvin
6,795,925	B2	9/2004	Colvin
6,799,277	B2	9/2004	Colvin
6,804,453	B1 *	10/2004	Sasamoto et al. 386/258
6,813,717	B2	11/2004	Colvin
6,813,718	B2	11/2004	Colvin
6,823,455	B1	11/2004	Macy et al.
6,834,308	B1	12/2004	Ikezoye et al.
6,842,862	B2	1/2005	Chow et al.
6,853,726	B1	2/2005	Moskowitz et al.
6,857,078	B2	2/2005	Colvin
6,865,747	B1	3/2005	Mercier
6,931,534	B1	8/2005	Jandel et al.
6,957,330	B1	10/2005	Hughes
6,966,002	B1	11/2005	Torrubia-Saez
6,977,894	B1	12/2005	Achilles et al.
6,978,370	B1	12/2005	Kocher
6,983,337	B2	1/2006	Diamant
6,986,063	B2	1/2006	Colvin
6,990,453	B2	1/2006	Wang
7,007,166	B1	2/2006	Moskowitz et al.
7,020,285	B1	3/2006	Kirovski et al.
7,035,049	B2	4/2006	Yamamoto
7,035,409	B1	4/2006	Moskowitz
7,043,050	B2	5/2006	Yuval
7,046,808	B1	5/2006	Metois et al.
7,050,396	B1	5/2006	Cohen et al.
7,051,208	B2	5/2006	Venkatesan et al.
7,058,570	B1	6/2006	Yu et al.
7,093,295	B1	8/2006	Saito
7,095,874	B2	8/2006	Moskowitz et al.
7,103,184	B2	9/2006	Jian
7,107,451	B2	9/2006	Moskowitz
7,123,718	B1	10/2006	Moskowitz et al.
7,127,615	B2	10/2006	Moskowitz
7,150,003	B2	12/2006	Naumovich et al.
7,152,162	B2	12/2006	Moskowitz et al.
7,159,116	B2	1/2007	Moskowitz
7,162,642	B2	1/2007	Schumann et al.
7,177,429	B2	2/2007	Moskowitz et al.
7,177,430	B2	2/2007	Kim
7,206,649	B2	4/2007	Kirovski et al.
7,231,524	B2	6/2007	Bums
7,233,669	B2	6/2007	Candelore
7,240,210	B2	7/2007	Michak et al.
7,266,697	B2	9/2007	Kirovski et al.
7,286,451	B2	10/2007	Wirtz
7,287,275	B2	10/2007	Moskowitz
7,289,643	B2	10/2007	Brunk et al.
7,343,492	B2	3/2008	Moskowitz et al.
7,346,472	B1	3/2008	Moskowitz et al.
7,362,775	B1	4/2008	Moskowitz
7,363,278	B2	4/2008	Schmelzer et al.
7,409,073	B2	8/2008	Moskowitz et al.
7,457,962	B2	11/2008	Moskowitz
7,460,994	B2	12/2008	Herre et al.
7,475,246	B1	1/2009	Moskowitz
7,530,102	B2	5/2009	Moskowitz
7,532,725	B2	5/2009	Moskowitz et al.
7,568,100	B1	7/2009	Moskowitz et al.
7,647,502	B2	1/2010	Moskowitz
7,647,503	B2	1/2010	Moskowitz
7,664,263	B2	2/2010	Moskowitz
7,743,001	B1	6/2010	Vermeulen
7,761,712	B2	7/2010	Moskowitz
7,779,261	B2	8/2010	Moskowitz
2001/0010078	A1	7/2001	Moskowitz
2001/0029580	A1	10/2001	Moskowitz
2001/0043594	A1	11/2001	Ogawa et al.
2002/0009208	A1	1/2002	Alattar
2002/0010684	A1	1/2002	Moskowitz
2002/0026343	A1	2/2002	Duenke
2002/0047873	A1	4/2002	Imanaka et al.
2002/0056041	A1	5/2002	Moskowitz
2002/0071556	A1	6/2002	Moskowitz et al.
2002/0073043	A1	6/2002	Herman et al.
2002/0097873	A1	7/2002	Petrovic
2002/0103883	A1	8/2002	Haverstock et al.
2002/0161741	A1	10/2002	Wang et al.
2003/0002862	A1	1/2003	Rodriguez
2003/0126445	A1	7/2003	Wehrenberg
2003/0133702	A1	7/2003	Collart
2003/0200439	A1	10/2003	Moskowitz
2003/0219143	A1	11/2003	Moskowitz et al.
2004/0028222	A1	2/2004	Sewell et al.
2004/0037449	A1	2/2004	Davis et al.
2004/0049695	A1	3/2004	Choi et al.
2004/0059918	A1	3/2004	Xu
2004/0083369	A1	4/2004	Erlingsson et al.
2004/0086119	A1	5/2004	Moskowitz
2004/0093521	A1	5/2004	Hamadeh et al.
2004/0117628	A1	6/2004	Colvin
2004/0117664	A1	6/2004	Colvin
2004/0125983	A1	7/2004	Reed et al.
2004/0128514	A1	7/2004	Rhoads
2004/0225894	A1	11/2004	Colvin
2004/0243540	A1	12/2004	Moskowitz et al.
2005/0135615	A1	6/2005	Moskowitz et al.
2005/0160271	A9	7/2005	Brundage et al.
2005/0177727	A1	8/2005	Moskowitz et al.
2005/0246554	A1	11/2005	Batson
2006/0005029	A1	1/2006	Petrovic et al.
2006/0013395	A1	1/2006	Brundage et al.
2006/0013451	A1	1/2006	Haitsma
2006/0041753	A1	2/2006	Haitsma
2006/0101269	A1	5/2006	Moskowitz et al.
2006/0140403	A1	6/2006	Moskowitz
2006/0251291	A1	11/2006	Rhoads
2006/0285722	A1	12/2006	Moskowitz et al.
2007/0011458	A1	1/2007	Moskowitz
2007/0028113	A1	2/2007	Moskowitz
2007/0064940	A1	3/2007	Moskowitz et al.
2007/0079131	A1	4/2007	Moskowitz et al.
2007/0083467	A1	4/2007	Lindahl et al.
2007/0110240	A1	5/2007	Moskowitz et al.
2007/0113094	A1	5/2007	Moskowitz et al.

2007/0127717	A1	6/2007	Herre et al.
2007/0226506	A1	9/2007	Moskowitz
2007/0253594	A1	11/2007	Lu et al.
2007/0294536	A1	12/2007	Moskowitz et al.
2007/0300072	A1	12/2007	Moskowitz
2007/0300073	A1	12/2007	Moskowitz
2008/0005571	A1	1/2008	Moskowitz
2008/0005572	A1	1/2008	Moskowitz
2008/0016365	A1	1/2008	Moskowitz
2008/0022113	A1	1/2008	Moskowitz
2008/0022114	A1	1/2008	Moskowitz
2008/0028222	A1	1/2008	Moskowitz
2008/0046742	A1	2/2008	Moskowitz
2008/0075277	A1	3/2008	Moskowitz et al.
2008/0109417	A1	5/2008	Moskowitz
2008/0133927	A1	6/2008	Moskowitz et al.
2008/0151934	A1	6/2008	Moskowitz et al.
2009/0037740	A1	2/2009	Moskowitz
2009/0089427	A1	4/2009	Moskowitz et al.
2009/0190754	A1	7/2009	Moskowitz et al.
2009/0210711	A1	8/2009	Moskowitz
2009/0220074	A1	9/2009	Moskowitz et al.
2010/0002904	A1	1/2010	Moskowitz
2010/0005308	A1	1/2010	Moskowitz
2010/0064140	A1	3/2010	Moskowitz
2010/0077219	A1	3/2010	Moskowitz
2010/0077220	A1	3/2010	Moskowitz
2010/0098251	A1	4/2010	Moskowitz
2010/0106736	A1	4/2010	Moskowitz
2010/0153734	A1	6/2010	Moskowitz
2010/0182570	A1	7/2010	Chota
2010/0202607	A1	8/2010	Moskowitz
2010/0220861	A1	9/2010	Moskowitz

FOREIGN PATENT DOCUMENTS

EP	0565947	10/1993
EP	0581317	2/1994
EP	0581317 A2	2/1994
EP	0649261	4/1995
EP	0651554	5/1995
EP	0872073	7/1996
EP	1547337	3/2006
EP	1354276	12/2007
NL	1005523	9/1998
WO	WO 9514289	5/1995
WO	WO 9629795	9/1996
WO	WO 9642151	12/1996
WO	WO9701892	1/1997
WO	WO9726733	1/1997
WO	WO 9724833	7/1997
WO	WO9726732	7/1997
WO	WO 9744736	11/1997
WO	WO9802864	1/1998
WO	WO9837513	8/1998
WO	WO 9952271	10/1999
WO	WO 9962044	12/1999
WO	WO 9963443	12/1999
WO	WO 0057643	9/2000
WO	WO0118628	3/2001
WO	WO0143026	6/2001
WO	WO00203385	1/2002
WO	WO02003385 A1	10/2002

OTHER PUBLICATIONS

Brealy, et al., Principles of Corporate Finance, "Appendix A—Using Option Valuation Models", 1984, pp. 448-449.
Copeland, et al., Real Options: A Practitioner's Guide, 2001 pp. 106-107, 201-202, 204-208.
Sarkar, M. "An Assessment of Pricing Mechanisms for the Internet—A Regulatory Imperative", presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/iep/works/SarkAsses.html on.
Crawford, D.W. "Pricing Network Usage: A Market for Bandwidth of Market Communication?" presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/iep/works/CrawMarket.html on March.
Low, S.H., "Equilibrium Allocation and Pricing of Variable Resources Among User-Suppliers", 1988. http://www.citesear.nj.nec.com/366503.html.
Caronni, Germano, "Assuring Ownership Rights for Digital Images", published proceeds of reliable IT systems, v15 '95, H.H. Bruggemann and W. Gerhardt-Hackel (Ed) Viewing Publishing Company Germany 1995.
Zhao, Jian. "A WWW Service to Embed and Prove Digital Copyright Watermarks", Proc. of the European conf. on Multimedia Applications, Services & Techniques Louvain-La-Nevve Belgium May 1996.
Gruhl, Daniel et al., Echo Hiding. In Proceeding of the Workshop on Information Hiding. No. 1174 in Lecture Notes in Computer Science, Cambridge, England (May/Jun. 1996).
Oomen, A.W.J. et al., A Variable Bit Rate Buried Data Channel for Compact Disc, J.AudioEng. Sc., vol. 43, No. 1/2, pp. 23-28 (1995).
Ten Kate, W. et al., A New Surround-Stereo-Surround Coding Techniques, J. Audio Eng.Soc., vol. 40,No. 5,pp. 376-383 (1992).
Gerzon, Michael et al., A High Rate Buried Data Channel for Audio CD, presentation notes, Audio Engineering Soc. 94th Convention (1993).
Sklar, Bernard, Digital Communications, pp. 601-603 (1988).
Jayant, N.S. et al., Digital Coding of Waveforms, Prentice Hall Inc., Englewood Cliffs, NJ, pp. 486-509 (1984).
Bender, Walter R. et al., Techniques for Data Hiding, SPIE Int. Soc. Opt. Eng., vol. 2420, pp. 164-173, 1995.
Zhao, Jian et al., Embedding Robust Labels into Images for Copyright Protection, (xp 000571976), pp. 242-251, 1995.
Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 175, 1997.
Schneier, Bruce, Applied Cryptography, 1st Ed., pp. 67-68, 1994.
Ten Kate, W. et al., "Digital Audio Carrying Extra Information", IEEE, CH 2847-2/90/0000-1097, (1990).
Van Schyndel, et al., "A digital Watermark," IEEE Int'l Computer Processing Conference, Austin,TX, Nov. 13-16, 1994, pp. 86-90.
Smith, et al. "Modulation and Information Hiding in Images", Springer Verlag, 1st Int'l Workshop, Cambridge, UK, May 30-Jun. 1, 1996, pp. 207-227.
1997, Kutter, Martin et al., "Digital Signature of Color Images Using Amplitude Modulation", SPIE-E197, vol. 3022, pp. 518-527.
Puate, Joan et al., "Using Fractal Compression Scheme to Embed a Digital Signature into an Image", SPIE-96 Proceedings, vol. 2915, Mar. 1997, pp. 108-118.
Swanson, Mitchell D.,et al., "Transparent Robust Image Watermarking", Proc. of the 1996 IEEE Int'l Conf. on Image Processing, vol. 111, 1996 , pp. 211-214.
Swanson, Mitchell D., et al. "Robust Data Hiding for Images", 7th IEEE Digital Signal Processing Workshop, Leon, Norway. Sep. 1-4, 1996, pp. 37-40.
Zhao, Jian et al., "Embedding Robust Labels into Images for Copyright Protection", Proceeding of the Know Right '95 Conference, pp. 242-251.
Koch, E., et al., "Towards Robust and Hidden Image Copyright Labeling", 1995 IEEE Workshop on Nonlinear Signal and Image Processing, Jun. 1995 Neos Marmaras pp. 4.
Van Schyandel, et al., "Towards a Robust Digital Watermark", Second Asain Image Processing Conference, Dec. 6-8, 1995, Singapore, vol. 2, pp. 504-508.
Tirkel,A.Z., "A Two-Dimensional Digital Watermark", DICTA '95, Univ. of Queensland, Brisbane, Dec. 5-8, 1995, pp. 7.
Tirkel,A.Z., "Image Watermarking—A Spread Spectrum Application", ISSSTA '96, Sep. 1996, Mainz, German, pp. 6.
O'Ruanaidh, et al. "Watermarking Digital Images for Copyright Protection", IEEE Proceedings, vol. 143, No. 4, Aug. 1996, pp. 250-256.
Cox, et al., Secure Spread Spectrum Watermarking for Multimedia, NEC Research Institude, Techinal Report 95-10, pp. 33.
Kahn, D., "The Code Breakers", The MacMillan Company, 1969, pp. xIII, 81-83, 513, 515, 522-526, 863.
Boney, et al., Digital Watermarks for Audio Signals, EVSIPCO, 96, pp. 473-480 (Mar. 14, 1997).
Dept. of Electrical Engineering, Del Ft University of Technology, Del ft The Netherlands, Cr.C. Langelaar et al.,"Copy Protection for Multimedia Data based on Labeling Techniques", Jul. 1996 9 pp.
F. Hartung, et al., "Digital Watermarking of Raw and Compressed Video", SPIE vol. 2952, pp. 205-213.

Craver, et al., "Can Invisible Watermarks Resolve Rightful Ownerships?", IBM Research Report, RC 20509 (Jul. 25, 1996) 21 pp.
Press, et al., "Numerical Recipes in C", Cambridge Univ. Press, 1988, pp. 398-417.
Pohlmann, Ken C., "Principles of Digital Audio", 3rd Ed., 1995, pp. 32-37, 40-48:138, 147-149, 332, 333, 364, 499-501, 508-509, 564-571.
Pohlmann, Ken C., "Principles of Digital Audio", 2nd Ed., 1991, pp. 1-9, 19-25, 30-33, 41-48, 54-57, 86-107, 375-387.
Schneier, Bruce, Applied Cryptography, John Wiley & Sons, Inc., New York, 1994, pp. 68, 69, 387-392, 1-57, 273-275, 321-324.
Boney, et al., Digital Watermarks for Audio Signals, Proceedings of the International Conf. on Multimedia Computing and Systems, Jun. 17-23, 1996 Hiroshima, Japan, 0-8186-7436-9196, pp. 473-480.
Johnson, et al., "Transform Permuted Watermarking for Copyright Protection of Digital Video", IEEE Globecom 1998, Nov. 8-12, 1998, New York New York vol. 2 1998 pp. 684-689 (ISBN 0-7803-4985-7).
Rivest, et al., "Pay Word and Micromint: Two Simple Micropayment Schemes," MIT Laboratory for Computer Science, Cambridge, MA, May 7, 1996 pp. 1-18.
Bender, et al., "Techniques for Data Hiding", IBM Systems Journal, (1996) vol. 35, Nos. 3 & 4,1996, pp. 313-336.
Moskowitz, "Bandwith as Currency", IEEE Multimedia, Jan.-Mar. 2003, pp. 14-21.
Moskowitz, Multimedia Security Technologies for Digital Rights Management, 2006, Academic Press, "Introduction—Digital Rights Management" pp. 3-22.
Rivest, et al., "PayWord and Micromint: Two Simple Micropayment Schemes," MIT Laboratory for Computer Science, Cambridge, MA, Apr. 27, 2001, pp. 1-18.
Tomsich, et al., "Towards a secure and de-centralized digital watermarking infrastructure for the protection of Intellectual Property", in Electronic Commerce and Web Technologies, Proceedings (ECWEB)(2000).
Moskowitz, "What is Acceptable Quality in the Application of Digital Watermarking: Trade-offs of Security; Robustness and Quality", IEEE Computer Society Proceedings of ITCC 2002 Apr. 10, 2002 pp. 80-84.
Lemma, et al. "Secure Watermark Embedding through Partial Encryption", International Workshop on Digital Watermarking ("IWDW" 2006). Springer Lecture Notes in Computer Science 2006 (to appear) 13.
Kocher, et al., "Self Protecting Digital Content", Technical Report from the CRI Content Security Research Initiative, Cryptography Research, Inc. 2002-2003 14 pages.
Sirbu, M. et al., "Net Bill: An Internet Commerce System Optimized for Network Delivered Services", Digest of Papers of the Computer Society Computer Conference (Spring) Mar. 5, 1995 pp. 20-25 vol. CONF40.
Schunter, M. et al., "A Status Report on the SEMPER framework for Secure Electronic Commerce", Computer Networks and ISDN Systems, Sep. 30, 1998, pp. 1501-1510 vol. 30 No. 16-18 NL North Holland.
Konrad, K. et al., "Trust and Electronic Commerce—more than a technical problem," Proceedings of the 18th IEEE Symposium on Reliable Distributed Systems Oct. 19-22, 1999, pp. 360-365 Lausanne.
Kini, et al., "Trust in Electronic Commerce: Definition and Theoretical Considerations", Proceedings of the 31st Hawaii Int'l Conf on System Sciences (Cat. No. 98TB100216). Jan. 6-9, 1998. pp. 51-61. Los.
Steinauer D. D., et al., "Trust and Traceability in Electronic Commerce", Standard View, Sep. 1997, pp. 118-124, vol. 5 No. 3, ACM, USA.
Hartung, et al. "Multimedia Watermarking Techniques", Proceedings of the IEEE, Special Issue, Identification & Protection of Multimedia Information, pp. 1079-1107 Jul. 1999 vol. 87 No. 7 IEEE.
European Search Report & European Search Opinion in EP07112420.
STAIND (The Singles 1996-2006), Warner Music—Atlantic, Pre-Release CD image, 2006, 1 page.
Radiohead ("Hail to the Thief"), EMI Music Group—Capitol, Pre-Release CD image, 2003, 1 page.
U.S. Appl. No. 60/169,274, filed Dec. 7, 1999, entitled "Systems, Methods and Devices for Trusted Transactions".
U.S. Appl. No. 60/234,199, filed Sep. 20, 2000, "Improved Security Based on Subliminal and Supraliminal Channels for Data Objects".
U.S. Appl. No. 09/671,739, filed Sep. 29, 2000, entitled "Method and Device for Monitoring and Analyzing Signals".
Tirkel, A.Z., "A Two Dimensional Digital Watermark", Scientific Technology, 686, 14, date unknown.
PCT International Search Report in PCT/US95/08159.
PCT International Search Report in PCT/US96/10257.
Supplementary European Search Report in EP 96919405.
PCT International Search Report in PCT/US97/00651.
PCT International Search Report in PCT/US97/00652.
PCT International Search Report in PCT/US97/11455.
PCT International Search Report in PCT/US99/07262.
PCT International Search Report in PCT/US00/06522.
Supplementary European Search Report in EP00919398.
PCT International Search Report in PCT/US00/18411.
PCT International Search Report in PCT/US00/33126.
PCT International Search Report in PCT/US00/21189.
Delaigle, J.-F., et al. "Digital Watermarking," Proceedings of the SPIE, vol. 2659, Feb. 1, 1996, pp. 99-110.
Schneider, M., et al. "A Robust Content Based Digital Signature for Image Authentication," Proceedings of the International Conference on Image Processing (IC. Lausanne) Sep. 16-19, 1996, pp. 227-230, IEEE ISBN.
Cox, I. J., et al. "Secure Spread Spectrum Watermarking for Multimedia," IEEE Transactions on Image Processing, vol. 6 No. 12, Dec. 1, 1997, pp. 1673-1686.
Wong, Ping Wah. "A Public Key Watermark for Image Verification and Authentication," IEEE International Conference on Image Processing, vol. 1 Oct. 4-7, 1998, pp. 455-459.
Fabien A.P. Petitcolas, Ross J. Anderson and Markkus G. Kuhn, "Attacks on Copyright Marking Systems," LNCS, vol. 1525, Apr. 14-17, 1998, pp. 218-238 ISBN: 3-540-65386-4.
Ross Anderson, "Stretching the Limits of Steganography," LNCS, vol. 1174, May/Jun. 1996, 10 pages, ISBN: 3-540-61996-8.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Image Watermarking", pre-publication, Summer 1997 4 pages.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Image Watermarking", Submitted to Signal Processing Aug. 21, 1997, 19 pages.
Oasis (Dig Out Your Soul), Big Brother Recordings Ltd, Promotional CD image, 2008, 1 page.
Rivest, R. "Chaffing and Winnowing: Confidentiality without Encryption", MIT Lab for Computer Science, http://people.csail.mit.edu/rivest/Chaffing.txt Apr. 24, 1998, 9 pp.
PortalPlayer, PP502 digital media management system-on-chip, May 1, 2003, 4 pp.
VeriDisc, "The Search for a Rational Solution to Digital Rights Management (DRM)", http://64.244.235.240/news/whitepaper, /docs/veridisc.sub.--white.sub.--paper.pdf, 2001, 15 pp.
Cayre, et al., "Kerckhoff's-Based Embedding Security Classes for WOA Data Hiding", IEEE Transactions on Information Forensics and Security, vol. 3 No. 1, Mar. 2008, 15 pp.
Wayback Machine, dated Jan. 17, 1999, http://web.archive.org/web/19990117020420/http://www.netzero.com/, accessed on Feb. 19, 2008.
Namgoong, H., "An Integrated Approach to Legacy Data for Multimedia Applications", Proceedings of the 23rd EUROMICRO Conference, vol., Issue 1-4, Sep. 1997, pp. 387-391.
Wayback Machine, dated Aug. 26, 2007, http://web.archive,org/web/20070826151732/http://www.screenplaysmag.com/t-abid/96/articleType/ArticleView/articleId/495/Default.aspx/.
"YouTube Copyright Policy: Video Identification tool—YouTube Help", accessed Jun. 4, 2009, http://www.google.com/support/youtube/bin/answer.py?h1=en&answer=83766, 3 pp.
PCT Application No. PCT/US95/08159, filed Jun. 26, 1995, entitled, "Digital Information Commodities Exchange with Virtual Menuing", published as WO/1997/001892; Publication Date: Jan. 16, 1997.

PCT Application No. PCT/US96/10257, filed Jun. 7, 1996, entitled "Steganographic Method and Device"—corresponding to—EPO Application No. 96919405.9, entitled "Steganographic Method and Device", published as WO/1996/042151; Publication Date: Dec. 27, 1996.
PCT Application No. PCT/US97/00651, filed Jan. 16, 1997, entitled, "Method for Stega-Cipher Protection of Computer Code", published as WO/1997/026732; Publication Date: Jul. 24, 1997.
PCT Application No. PCT/US97/00652, filed Jan. 17, 1997, entitled, "Method for an Encrypted Digital Watermark", published as WO/1997/026733; Publication Date: Jul. 24, 1997.
PCT Application No. PCT/US97/11455, filed Jul. 2, 1997, entitled, "Optimization Methods for the Insertion, Protection and Detection of Digital Watermarks in Digitized Data", published as WO/1998/002864; Publication Date: Jan. 22, 1998.
PCT Application No. PCT/US99/07262, filed Apr. 2, 1999, entitled, "Multiple Transform Utilization and Applications for Secure Digital Watermarking", published as WO/1999/052271; Publication Date: Oct. 14, 1999.
PCT Application No. PCT/US00/06522, filed Mar. 14, 2000, entitled, "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as WO/2000/057643; Publication Date: Sep. 28, 2000.
PCT Application No. PCT/US00/18411, filed Jul. 5, 2000, entitled, "Copy Protection of Digital Data Combining Steganographic and Cryptographic Techniques".
PCT Application No. PCT/US00/33126, filed Dec. 7, 2000, entitled "Systems, Methods and Devices for Trusted Transactions", published as WO/2001/043026; Publication Date: Jun. 14, 2001.
EPO Divisional Patent Application No. 07112420.0, entitled "Steganographic Method and Device" corresponding to PCT Application No. PCT/US96/10257, published as WO/1996/042151, Dec. 27, 1996.
U.S. Appl. No. 60/222,023, filed Jul. 31, 2007 entitled "Method and apparatus for recognizing sound and signals in high noise and distortion".
"Techniques for Data Hiding in Audio Files," by Morimoto, 1995.
Howe, Dennis Jul. 13, 1998 http://foldoc..org//steganography.
CSG, Computer Support Group and CSGNetwork.com 1973 http://www.csgnetwork.com/glossarys.html.
QuinStreet Inc. 2010 What is steganography?—A word definition from the Webopedia Computer Dictionary http://www.webopedia.com/terms/steganography.html.
Graham, Robert Aug. 21, 2000 "Hacking Lexicon" http://robertgraham.com/pubs/hacking-dict.html.
Farkex, Inc 2010 "Steganography definition of steganography in the Free Online Encyclopedia" http://encyclopedia2.Thefreedictionary.com/steganography.
Horowitz, et al., The Art of Eletronics. 2nd Ed., 1989, pp7.
Jimmy eat world ("futures"), Interscope Records, Pre-Release CD image, 2004, 1 page.
Aerosmith ("Just Push Play"), Pre-Release CD image, 2001, 1 page.
Phil Collins(Testify) Atlantic, Pre-Release CD image, 2002, 1 page.
U.S. Appl. No. 11/599,838, filed Nov. 15, 2006.
U.S. Appl. No. 11/899,662, filed Sep. 7, 2007.
U.S. Appl. No. 10/369,344, filed Feb. 18, 2003.
U.S. Appl. No. 11/482,654, filed Jul. 7, 2006.
U.S. Appl. No. 12/215,812, filed Jun. 30, 2008.
U.S. Appl. No. 12/901,568, filed Oct. 10, 2010.
U.S. Appl. No. 11/497,822, filed Aug. 2, 2006.
U.S. Appl. No. 12/217,834, filed Jul. 9, 2008.
U.S. Appl. No. 12/462,799, filed Aug. 10, 2009.
U.S. Appl. No. 11/899,661, filed Sep. 7, 2007.
U.S. Appl. No. 12/590,681, filed Nov. 19, 2009.
U.S. Appl. No. 11/897,791, filed Aug. 31, 2007.
U.S. Appl. No. 12/590,553, filed Nov. 10, 2009.
U.S. Appl. No. 12/592,331, filed Nov. 23, 2009.
U.S. Appl. No. 12/009,914, filed Jan. 23, 2008.
U.S. Appl. No. 12/005,230, filed Dec. 26, 2007.
U.S. Appl. No. 12/803,168, filed Jun. 21, 2010.
U.S. Appl. No. 11/649,026, filed Jan. 3, 2007.
U.S. Appl. No. 12/803,194, filed Jun. 21, 2010.
U.S. Appl. No. 12/892,900, filed Sep. 28, 2010.
U.S. Appl. No. 08/999,766, filed Jul. 23, 1997.
U.S. Appl. No. 11/894,476, filed Aug. 21, 2007.
U.S. Appl. No. 11/050,779, filed Feb. 7, 2005.
U.S. Appl. No. 12/802,519, filed Jun. 8, 2010.
U.S. Appl. No. 12/383,916, filed Mar. 30, 2009.
U.S. Appl. No. 11/894,443, filed Aug. 21, 2007.
U.S. Appl. No. 12/913,751, filed Oct. 27, 2010.
U.S. Appl. No. 11/512,701, filed Aug. 29, 2006.
U.S. Appl. No. 11/895,388, filed Aug. 24, 2007.
U.S. Appl. No. 12/383,879, filed Mar. 30, 2009.
U.S. Appl. No. 12/886,732, filed Sep. 21, 2010.
U.S. Appl. No. 12/287,443, filed Oct. 9, 2008.
U.S. Appl. No. 12/655,357, filed Dec. 22, 2009.
U.S. Appl. No. 13/035,964, filed Feb. 26, 2011.
U.S. Appl. No. 11/900,065, filed Sep. 10, 2007.
U.S. Appl. No. 12/799,894, filed May 4, 2010.

* cited by examiner

METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Ser. No. 12/655,357, filed Dec. 22, 2009 now U.S. Pat. No. 7,949,494, which is a continuation of application Ser. No. 12/005,229, filed Dec. 26, 2007, now U.S. Pat. No. 7,660,700, which is a continuation of application Ser. No. 09/657,181, filed Sep. 7, 2000, now U.S. Pat. No. 7,346,472. The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties, as if fully stated herein.

This application is related to U.S. patent application Ser. No. 08/999,766, filed Jul. 23, 1997, entitled "Steganographic Method and Device" (issued as U.S. Pat. No. 7,568,100); U.S. patent application Ser. No. 08/772,222, filed Dec. 20, 1996, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,078,664); U.S. patent application Ser. No. 09/456,319, filed Dec. 8, 1999, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,853,726); U.S. patent application Ser. No. 08/674,726, filed Jul. 2, 1996, entitled "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (issued as U.S. Pat. No. 7,362,775); U.S. patent application Ser. No. 09/545,589, filed Apr. 7, 2000, entitled "Method and System for Digital Watermarking" (issued as U.S. Pat. No. 7,007,166); U.S. patent application Ser. No. 09/046,627, filed Mar. 24, 1998, entitled "Method for Combining Transfer Function with Predetermined Key Creation" (issued as U.S. Pat. No. 6,598,162); U.S. patent application Ser. No. 09/053,628, filed Apr. 2, 1998, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking" (issued as U.S. Pat. No. 6,205,249); U.S. patent application Ser. No. 09/281,279, filed Mar. 30, 1999, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data (issued as U.S. Pat. No. 6,522,767)"; U.S. patent application Ser. No. 09,594,719, filed Jun. 16, 2000, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems" (which is a continuation-in-part of PCT application No. PCT/US00/06522, filed Mar. 14, 2000, which PCT application claimed priority to U.S. Provisional Application No. 60/125,990, filed Mar. 24, 1999) (issued as U.S. Pat. No. 7,123,718); U.S. Application No. 60/169,274, filed Dec. 7, 1999, entitled "Systems, Methods And Devices For Trusted Transactions" (issued as U.S. Pat. No. 7,159,116); and PCT Application No. PCT/US00/21189, filed Aug. 4, 2000 (which claims priority to U.S. patent application Ser. No. 60/147,134, filed Aug. 4, 1999, and to U.S. patent application Ser. No. 60/213,489, filed Jun. 23, 2000, both of which are entitled, "A Secure Personal Content Server") (issued as U.S. Pat. No. 7,475,246). The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties, as if fully stated herein.

In addition, this application hereby incorporates by reference, as if fully stated herein, the total disclosures of U.S. Pat. No. 5,613,004 "Steganographic Method and Device"; U.S. Pat. No. 5,745,569 "Method for Stega-Cipher Protection of Computer Code"; and U.S. Pat. No. 5,889,868 "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data."

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to the monitoring and analysis of digital information. A method and device are described which relate to signal recognition to enhance identification and monitoring activities.

2. Description of the Related Art

Many methods and protocols are known for transmitting data in digital form for multimedia applications (including computer applications delivered over public networks such as the internet or World Wide Web ("WWW"). These methods may include protocols for the compression of data, such that it may more readily and quickly be delivered over limited bandwidth data lines. Among standard protocols for data compression of digital files may be mentioned the MPEG compression standards for audio and video digital compression, promulgated by the Moving Picture Experts Group. Numerous standard reference works and patents discuss such compression and transmission standards for digitized information.

Digital watermarks help to authenticate the content of digitized multimedia information, and can also discourage piracy. Because piracy is clearly a disincentive to the digital distribution of copyrighted content, establishment of responsibility for copies and derivative copies of such works is invaluable. In considering the various forms of multimedia content, whether "master," stereo, NTSC video, audio tape or compact disc, tolerance of quality will vary with individuals and affect the underlying commercial and aesthetic value of the content. It is desirable to tie copyrights, ownership rights, purchaser information or some combination of these and related data into the content in such a manner that the content must undergo damage, and therefore reduction of its value, with subsequent, unauthorized distribution, commercial or otherwise. Digital watermarks address many of these concerns. A general discussion of digital watermarking as it has been applied in the art may be found in U.S. Pat. No. 5,687,236 (whose specification is incorporated in whole herein by reference).

Further applications of basic digital watermarking functionality have also been developed. Examples of such applications are shown in U.S. Pat. No. 5,889,868 (whose specification is incorporated in whole herein by reference). Such applications have been drawn, for instance, to implementations of digital watermarks that were deemed most suited to particular transmissions, or particular distribution and storage mediums, given the nature of digitally sampled audio, video, and other multimedia works. There have also been developed techniques for adapting watermark application parameters to the individual characteristics of a given digital sample stream, and for implementation of digital watermarks that are feature-based—i.e., a system in which watermark information is not carried in individual samples, but is carried in the relationships between multiple samples, such as in a waveform shape. For instance, natural extensions may be added to digital watermarks that may also separate frequencies (color or audio), channels in 3D while utilizing discreteness in feature-based encoding only known to those with pseudo-random keys (i.e., cryptographic keys) or possibly tools to access such information, which may one day exist on a quantum level.

A matter of general weakness in digital watermark technology relates directly to the manner of implementation of the watermark. Many approaches to digital watermarking leave detection and decode control with the implementing party of the digital watermark, not the creator of the work to be pro-

tected. This weakness removes proper economic incentives for improvement of the technology. One specific form of exploitation mostly regards efforts to obscure subsequent watermark detection. Others regard successful over encoding using the same watermarking process at a subsequent time. Yet another way to perform secure digital watermark implementation is through "key-based" approaches.

SUMMARY OF THE INVENTION

A method for monitoring and analyzing at least one signal is disclosed, which method comprises the steps of: receiving at least one reference signal to be monitored; creating an abstract of the at least one reference signal; storing the abstract of the at least one reference signal in a reference database; receiving at least one query signal to be analyzed; creating an abstract of the at least one query signal; and comparing the abstract of the at least one query signal to the abstract of the at least one reference signal to determine if the abstract of the at least one query signal matches the abstract of the at least one reference signal.

A method for monitoring a plurality of reference signals is also disclosed, which method comprises the steps of: creating an abstract for each one of a plurality of reference signals; storing each of the abstracts in a reference database; receiving at least one query signal to be analyzed; creating an abstract of each at least one query signal; locating an abstract in the reference database that matches the abstract of each at least one query signal; and recording the identify of the reference signal whose abstract matched the abstract of each at least one query signal.

A computerized system for monitoring and analyzing at least one signal is also disclosed, which system comprises: a processor for creating an abstract of a signal using selectable criteria; a first input for receiving at least one reference signal to be monitored, the first input being coupled to the processor such that the processor may generate an abstract for each reference signal input to the processor; a reference database, coupled to the processor, for storing abstracts of each at least one reference signal; a second input for receiving at least one query signal to be analyzed, the second input being coupled to the processor such that the processor may generate an abstract for each query signal; and a comparing device, coupled to the reference database and to the second input, for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

Further, an electronic system for monitoring and analyzing at least one signal is disclosed, which system comprises: a first input for receiving at least one reference signal to be monitored, a first processor for creating an abstract of each reference signal input to the first processor through the first input; a second input for receiving at least one query signal to be analyzed, a second processor for creating an abstract of each query signal; a reference database for storing abstracts of each at least one reference signal; and a comparing device for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

DETAILED DESCRIPTION OF THE INVENTION

While there are many approaches to data reduction that can be utilized, a primary concern is the ability to reduce the digital signal in such a manner as to retain a "perceptual relationship" between the original signal and its data reduced version. This relationship may either be mathematically discernible or a result of market-dictated needs. The purpose is to afford a more consistent means for classifying signals than proprietary, related text-based approaches. A simple analogy is the way in which a forensic investigator uses a sketch artist to assist in determining the identity of a human.

In one embodiment of the invention, the abstract of a signal may be generated by the following steps: 1) analyze the characteristics of each signal in a group of audible/perceptible variations for the same signal (e.g., analyze each of five versions of the same song—which versions may have the same lyrics and music but which are sung by different artists); and 2) select those characteristics which achieve or remain relatively constant (or in other words, which have minimum variation) for each of the signals in the group. Optionally, the null case may be defined using those characteristics which are common to each member of the group of versions.

Lossless and lossy compression schemes are appropriate candidates for data reduction technologies, as are those subset of approaches that are based on perceptual models, such as AAC, MP3, TwinVQ, JPEG, GIF, MPEG, etc. Where spectral transforms fail to assist in greater data reduction of the signal, other signal characteristics can be identified as candidates for further data reduction. Linear predictive coding (LPC), z-transform analysis, root mean square (rms), signal to peak, may be appropriate tools to measure signal characteristics, but other approaches or combinations of signal characteristic analysis are contemplated. While such signal characteristics may assist in determining particular applications of the present invention, a generalized approach to signal recognition is necessary to optimize the deployment and use of the present invention.

Increasingly, valuable information is being created and stored in digital form. For example, music, photographs and motion pictures can all be stored and transmitted as a series of binary digits—1's and 0's. Digital techniques permit the original information to be duplicated repeatedly with perfect or near perfect accuracy, and each copy is perceived by viewers or listeners as indistinguishable from the original signal. Unfortunately, digital techniques also permit the information to be easily copied without the owner's permission. While digital representations of analog waveforms may be analyzed by perceptually-based or perceptually-limited analysis it is usually costly and time-consuming to model the processes of the highly effective ability of humans to identify and recognize a signal. In those applications where analog signals require analysis, the cost of digitizing the analog signal is minimal when compared to the benefits of increased accuracy and speed of signal analysis and monitoring when the processes contemplated by this invention are utilized.

The present invention relates to identification of digitally-sampled information, such as images, audio and video. Traditional methods of identification and monitoring of those signals do not rely on "perceptual quality," but rather upon a separate and additional signal. Within this application, such signals will be called "additive signals" as they provide information about the original images, audio or video, but such information is in addition to the original signal. One traditional, text-based additive signal is title and author information. The title and author, for example, is information about a book, but it is in addition to the text of the book. If a book is being duplicated digitally, the title and author could provide one means of monitoring the number of times the text is being duplicated, for example, through an Internet download. The present invention, however, is directed to the identification of a digital signal—whether text, audio, or video—using only the digital signal itself and then monitoring the number of

times the signal is duplicated. Reliance on an additive signal has many shortcomings. For example, first, someone must incorporate the additive signal within the digital data being transmitted, for example, by concatenation or through an embedding process. Such an additive signal, however, can be easily identified and removed by one who wants to utilize the original signal without paying for its usage. If the original signal itself is used to identify the content, an unauthorized user could not avoid payment of a royalty simply by removing the additive signal—because there is no additive signal to remove. Hence, the present invention avoids a major disadvantage of the prior art.

One such additive signal that may be utilized is a digital watermark—which ideally cannot be removed without perceptually altering the original signal. A watermark may also be used as a monitoring signal (for example, by encoding an identifier that uniquely identifies the original digital signal into which the identifier is being embedded). A digital watermark used for monitoring is also an additive signal, and such a signal may make it difficult for the user who wants to duplicate a signal without paying a royalty—mainly by degrading the perceptual quality of the original signal if the watermark (and hence the additive monitoring signal) is removed. This is, however, is a different solution to the problem.

The present invention eliminates the need of any additive monitoring signal because the present invention utilizes the underlying content signal as the identifier itself. Nevertheless, the watermark may increase the value of monitoring techniques by increasing the integrity of the embedded data and by indicating tampering of either the original content signal or the monitoring signal. Moreover, the design of a watermarking embedding algorithm is closely related to the perceptibility of noise in any given signal and can represent an ideal subset of the original signal: the watermark bits are an inverse of the signal to the extent that lossy compression schemes, which can be used, for instance, to optimize a watermarking embedding scheme, can yield information about the extent to which a data signal can be compressed while holding steadfast to the design requirement that the compressed signal maintain its perceptual relationship with the original, uncompressed signal. By describing those bits that are candidates for imperceptible embedding of watermark bits, further data reduction may be applied on the candidate watermarks as an example of retaining a logical and perceptible relationship with the original uncompressed signal.

Of course, the present invention may be used in conjunction with watermarking technology (including the use of keys to accomplish secure digital watermarking), but watermarking is not necessary to practice the present invention. Keys for watermarking may have many forms, including: descriptions of the original carrier file formatting, mapping of embedded data (actually imperceptible changes made to the carrier signal and referenced to the predetermined key or key pairs), assisting in establishing the watermark message data integrity (by incorporation of special one way functions in the watermark message data or key), etc. Discussions of these systems in the patents and pending patent applications are incorporated by reference above. The "recognition" of a particular signal or an instance of its transmission, and its monitoring are operations that may be optimized through the use of digital watermark analysis.

A practical difference between the two approaches of using a separate, additive monitoring signal and using the original signal itself as the monitoring signal is control. If a separate signal is used for monitoring, then the originator of the text, audio or video signal being transmitted and the entity doing

the monitoring have to agree as to the nature of the separate signal to be used for monitoring—otherwise, the entity doing the monitoring would not know where to look, for what to look, or how to interpret the monitoring signal once it was identified and detected. On the other hand, if the original signal is used itself as a monitoring signal, then no such agreement is necessary. Moreover, a more logical and self-sufficient relationship between the original and its data-reduced abstract enhances the transparency of any resulting monitoring efforts. The entity doing the monitoring is not looking for a separate, additive monitoring system, and further, need not have to interpret the content of the monitoring signal.

Monitoring implementations can be handled by robust watermark techniques (those techniques that are able to survive many signal manipulations but are not inherently "secure" for verification of a carrier signal absent a logically-related watermarking key) and forensic watermark techniques (which enable embedding of watermarks that are not able to survive perceptible alteration of the carrier signal and thus enable detection of tampering with the originally watermarked carrier signal). The techniques have obvious trade-offs between speed, performance and security of the embedded watermark data.

In other disclosures, we suggest improvements and implementations that relate to digital watermarks in particular and embedded signaling in general. A digital watermark may be used to "tag" content in a manner that is not humanly-perceptible, in order to ensure that the human perception of the signal quality is maintained. Watermarking, however, must inherently alter at least one data bit of the original signal to represent a minimal change from the original signal's "unwatermarked state." The changes may affect only a bit, at the very least, or be dependent on information hiding relating to signal characteristics, such as phase information, differences between digitized samples, root mean square (RMS) calculations, z-transform analysis, or similar signal characteristic category.

There are weaknesses in using digital watermark technology for monitoring purposes. One weakness relates directly to the way in which watermarks are implemented. Often, the persons responsible for encoding and decoding the digital watermark are not the creator of the valuable work to be protected. As such, the creator has no input on the placement of the monitoring signal within the valuable work being protected. Hence, if a user wishing to avoid payment of the royalty can find a way to decode or remove the watermark, or at least the monitoring signal embedded in the watermark, then the unauthorized user may successfully duplicate the signal with impunity. This could occur, for example, if either of the persons responsible for encoding or decoding were to have their security compromised such that the encoding or decoding algorithms were discovered by the unauthorized user.

With the present invention, no such disadvantages exist because the creator need not rely on anyone to insert a monitoring signal—as no such signal is necessary. Instead, the creator's work itself is used as the monitoring signal. Accordingly, the value in the signal will have a strong relationship with its recognizability.

By way of improving methods for efficient monitoring as well as effective confirmation of the identity of a digitally-sampled signal, the present invention describes useful methods for using digital signal processing for benchmarking a novel basis for differencing signals with binary data comparisons. These techniques may be complemented with perceptual techniques, but are intended to leverage the generally

decreasing cost of bandwidth and signal processing power in an age of increasing availability and exchange of digitized binary data.

So long as there exist computationally inexpensive ways of identifying an entire signal with some fractional representation or relationship with the original signal, or its perceptually observable representation, we envision methods for faster and more accurate auditing of signals as they are played, distributed or otherwise shared amongst providers (transmitters) and consumers (receivers). The ability to massively compress a signal to its essence—which is not strictly equivalent to "lossy" or "lossless" compression schemes or perceptual coding techniques, but designed to preserve some underlying "aesthetic quality" of the signal—represents a useful means for signal analysis in a wide variety of applications. The signal analysis, however, must maintain the ability to distinguish the perceptual quality of the signals being compared. For example, a method which analyzed a portion of a song by compressing it to a single line of lyrics fails to maintain the ability to distinguish the perceptual quality of the songs being compared. Specifically, for example, if the song "New York State of Mind" were compressed to the lyrics "I'm in a New York State of Mind," such a compression fails to maintain the ability to distinguish between the various recorded versions of the song, say, for example between Billy Joel's recording and Barbara Streisand's recording. Such a method is, therefore, incapable of providing accurate monitoring of the artist's recordings because it could not determine which of the two artists is deserving of a royalty—unless of course, there is a separate monitoring signal to provide the name of the artist or other information sufficient to distinguish the two versions. The present invention, however, aims to maintain some level of perceptual quality of the signals being compared and would deem such a compression to be excessive.

This analogy can be made clearer if it is understood that there are a large number of approaches to compressing a signal to, say, $1/10{,}000^{th}$ of its original size, not for maintaining its signal quality to ensure computational ease for commercial quality distribution, but to assist in identification, analysis or monitoring of the signal. Most compression is either lossy or lossless and is designed with psychoacoustic or psychovisual parameters. That is to say, the signal is compressed to retain what is "humanly-perceptible." As long as the compression successfully mimics human perception, data space may be saved when the compressed file is compared to the uncompressed or original file. While psychoacoustic and psychovisual compression has some relevance to the present invention, additional data reduction or massive compression is anticipated by the present invention. It is anticipated that the original signal may be compressed to create a realistic or self-similar representation of the original signal, so that the compressed signal can be referenced at a subsequent time as unique binary data that has computational relevance to the original signal. Depending on the application, general data reduction of the original signal can be as simple as massive compression or may relate to the watermark encoding envelope parameter (those bits which a watermarking encoding algorithm deem as candidate bits for mapping independent data or those bits deemed imperceptible to human senses but detectable to a watermark detection algorithm). In this manner, certain media which are commonly known by signal characteristics, a painting, a song, a TV commercial, a dialect, etc., may be analyzed more accurately, and perhaps, more efficiently than a text-based descriptor of the signal. So long as the sender and receiver agree that the data representation is accurate, even insofar as the data-reduction technique has logical relationships with the perceptibility of the original

signal, as they must with commonly agreed to text descriptors, no independent cataloging is necessary.

The present invention generally contemplates a signal recognition system that has at least five elements. The actual number of elements may vary depending on the number of domains in which a signal resides (for example, audio is at least one domain while visual carriers are at least two dimensional). The present invention contemplates that the number of elements will be sufficient to effectively and efficiently meet the demands of various classes of signal recognition. The design of the signal recognition that may be used with data reduction is better understood in the context of the general requirements of a pattern or signal recognition system.

The first element is the reference database, which contains information about a plurality of potential signals that will be monitored. In one form, the reference database would contain digital copies of original works of art as they are recorded by the various artists, for example, contain digital copies of all songs that will be played by a particular radio station. In another form, the reference database would contain not perfect digital copies of original works of art, but digital copies of abstracted works of art, for example, contain digital copies of all songs that have been preprocessed such that the copies represent the perceptual characteristics of the original songs. In another form, the reference database would contain digital copies of processed data files, which files represent works of art that have been preprocessed in such a fashion as to identify those perceptual differences that can differentiate one version of a work of art from another version of the same work of art, such as two or more versions of the same song, but by different artists. These examples have obvious application to visually communicated works such as images, trademarks or photographs, and video as well.

The second element is the object locator, which is able to segment a portion of a signal being monitored for analysis (i.e., the "monitored signal"). The segmented portion is also referred to as an "object." As such, the signal being monitored may be thought of comprising a set of objects. A song recording, for example, can be thought of as having a multitude of objects. The objects need not be of uniform length, size, or content, but merely be a sample of the signal being monitored. Visually communicated informational signals have related objects; color and size are examples.

The third element is the feature selector, which is able to analyze a selected object and identify perceptual features of the object that can be used to uniquely describe the selected object. Ideally, the feature selector can identify all, or nearly all, of the perceptual qualities of the object that differentiate it from a similarly selected object of other signals. Simply, a feature selector has a direct relationship with the perceptibility of features commonly observed. Counterfeiting is an activity which specifically seeks out features to misrepresent the authenticity of any given object. Highly granular, and arguably successful, counterfeiting is typically sought for objects that are easily recognizable and valuable, for example, currency, stamps, and trademarked or copyrighted works and objects that have value to a body politic.

The fourth element is the comparing device which is able to compare the selected object using the features selected by the feature selector to the plurality of signals in the reference database to identify which of the signals matches the monitored signal. Depending upon how the information of the plurality of signals is stored in the reference database and depending upon the available computational capacity (e.g., speed and efficiency), the exact nature of the comparison will vary. For example, the comparing device may compare the selected object directly to the signal information stored in the

database. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector and then compare the selected object to the processed signal information. Alternatively, the comparing device may need to process the selected object using input from the feature selector and then compare the processed selected object to the signal information. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector, process the selected object using input from the feature selector, and then compare the processed selected object to the processed signal information.

The fifth element is the recorder which records information about the number of times a given signal is analyzed and detected. The recorder may comprise a database which keeps track of the number of times a song, image, or a movie has been played, or may generate a serial output which can be subsequently processed to determine the total number of times various signals have been detected.

Other elements may be added to the system or incorporated into the five elements identified above. For example, an error handler may be incorporated into the comparing device. If the comparing device identifies multiple signals which appear to contain the object being sought for analysis or monitoring, the error handler may offer further processing in order to identify additional qualities or features in the selected object such that only one of the set of captured signals is found to contain the further analyzed selected object that actually conforms with the object thought to have been transmitted or distributed.

Moreover, one or more of the five identified elements may be implemented with software that runs on the same processor, or which uses multiple processors. In addition, the elements may incorporate dynamic approaches that utilize stochastic, heuristic, or experience-based adjustments to refine the signal analysis being conducted within the system, including, for example, the signal analyses being performed within the feature selector and the comparing device. This additional analyses may be viewed as filters that are designed to meet the expectations of accuracy or speed for any intended application.

Since maintenance of original signal quality is not required by the present invention, increased efficiencies in processing and identification of signals can be achieved. The present invention concerns itself with perceptible relationships only to the extent that efficiencies can be achieved both in accuracy and speed with enabling logical relationships between an original signal and its abstract.

The challenge is to maximize the ability to sufficiently compress a signal to both retain its relationship with the original signal while reducing the data overhead to enable more efficient analysis, archiving and monitoring of these signals. In some cases, data reduction alone will not suffice: the sender and receiver must agree to the accuracy of the recognition. In other cases, agreement will actually depend on a third party who authored or created the signal in question. A digitized signal may have parameters to assist in establishing more accurate identification, for example, a "signal abstract" which naturally, or by agreement with the creator, the copyright owner or other interested parties, can be used to describe the original signal. By utilizing less than the original signal, a computationally inexpensive means of identification can be used. As long as a realistic set of conditions can be arrived at governing the relationship between a signal and its data reduced abstract, increases in effective monitoring and transparency of information data flow across communications channels is likely to result. This feature is significant in that it represents an improvement over how a digitally-

sampled signal can be cataloged and identified, though the use of a means that is specifically selected based upon the strengths of a general computing device and the economic needs of a particular market for the digitized information data being monitored. The additional benefit is a more open means to uniformly catalog, analyze, and monitor signals. As well, such benefits can exist for third parties, who have a significant interest in the signal but are not the sender or receiver of said information.

As a general improvement over the art, the present invention incorporates what could best be described as "computer-acoustic" and "computer-visual" modeling, where the signal abstracts are created using data reduction techniques to determine the smallest amount of data, at least a single bit, which can represent and differentiate two digitized signal representations for a given predefined signal set. Each of such representations must have at least a one bit difference with all other members of the database to differentiate each such representation from the others in the database. The predefined signal set is the object being analyzed. The signal identifier/detector should receive its parameters from a database engine. The engine will identify those characteristics (for example, the differences) that can be used to distinguish one digital signal from all other digital signals that are stored in its collection. For those digital signals or objects which are seemingly identical, except[ing] that the signal may have different performance or utilization in the newly created object, benefits over additive or text-based identifiers are achieved. Additionally, decisions regarding the success or failure of an accurate detection of any given object may be flexibly implemented or changed to reflect market-based demands of the engine. Appropriate examples are songs or works or art which have been sampled or reproduced by others who are not the original creator.

In some cases, the engine will also consider the NULL case for a generalized item not in its database, or perhaps in situations where data objects may have collisions. For some applications, the NULL case is not necessary, thus making the whole system faster. For instance, databases which have fewer repetitions of objects or those systems which are intended to recognize signals with time constraints or capture all data objects. Greater efficiency in processing a relational database can be obtained because the rules for comparison are selected for the maximum efficiency of the processing hardware and/or software, whether or not the processing is based on psychoacoustic or psychovisual models. The benefits of massive data reduction, flexibility in constructing appropriate signal recognition protocols and incorporation of cryptographic techniques to further add accuracy and confidence in the system are clearly improvements over the art. For example, where the data reduced abstract needs to have further uniqueness, a hash or signature may be required. And for objects which have further uniqueness requirements, two identical instances of the object could be made unique with cryptographic techniques.

Accuracy in processing and identification may be increased by using one or more of the following fidelity evaluation functions:

1) RMS (root mean square). For example, a RMS function may be used to assist in determining the distance between data based on mathematically determinable Euclidean distance between the beginning and end data points (bits) of a particular signal carrier.

2) Frequency weighted RMS. For example, different weights may be applied to different frequency components of the carrier signal before using RMS. This selective weighting can assist in further distinguishing the distance between

beginning and end points of the signal carrier (at a given point in time, described as bandwidth, or the number of total bits that can be transmitted per second) and may be considered to be the mathematical equivalent of passing a carrier signal difference through a data filter and figuring the average power in the output carrier.

3) Absolute error criteria, including particularly the NULL set (described above) The NULL may be utilized in two significant cases: First, in instances where the recognized, signal appears to be an identified object which is inaccurately attributed or identified to an object not handled by the database of objects; and second, where a collision of data occurs. For instance, if an artist releases a second performance of a previously recorded song, and the two performances are so similar that their differences are almost imperceptible, then the previously selected criteria may not be able to differentiate the two recordings. Hence, the database must be "recalibrated" to be able to differentiate these two versions. Similarly, if the system identifies not one, but two or more, matches for a particular search, then the database may need "recalibration" to further differentiate the two objects stored in the database.

4) Cognitive Identification. For example, the present invention may use an experience-based analysis within a recognition engine. Once such analysis may involve mathematically determining a spectral transform or its equivalent of the carrier signal. A spectral transform enables signal processing and should maintain, for certain applications, some cognitive or perceptual relationship with the original analog waveform. As a novel feature to the present invention, additional classes may be subject to humanly-perceptible observation. For instance, an experience-based criteria which relates particularly to the envisioned or perceived accuracy of the data information object as it is used or applied in a particular market, product, or implementation. This may include a short 3 second segment of a commercially available and recognizable song which is used for commercials to enable recognition of the good or service being marketed. The complete song is marketed as a separately valued object from the use of a discrete segment of the song (that may be used for promotion or marketing—for the complete song or for an entirely different good or service). To the extent that an owner of the song in question is able to further enable value through the licensing or agreement for use of a segment of the original signal, cognitive identification is a form of filtering to enable differentiations between different and intended uses of the same or subset of the same signal (object). The implementation relating specifically, as disclosed herein, to the predetermined identification or recognition means and/or any specified relationship with subsequent use of the identification means can be used to create a history as to how often a particular signal is misidentified, which history can then be used to optimize identification of that signal in the future. The difference between use of an excerpt of the song to promote a separate and distinct good or service and use of the excerpt to promote recognition of the song itself (for example, by the artist to sell copies of the song) relates informationally to a decision based on recognized and approved use of the song. Both the song and applications of the song in its entirety or as a subset are typically based on agreement by the creator and the sender who seeks to utilize the work. Trust in the means for identification, which can be weighted in the present invention (for example, by adjusting bit-addressable information), is an important factor in adjusting the monitoring or recognition features of the object or carrier signal, and by using any misidentification information, (including any experience-based or heuristic information), additional features of the monitored signal can be used to improve the performance of the monitoring system envisioned herein. The issue of central concern with cognitive identification is a greater understanding of the parameters by which any given object is to be analyzed. To the extent that a creator chooses varying and separate application of his object, those applications having a cognitive difference in a signal recognition sense (e.g., the whole or an excerpt), the system contemplated herein includes rules for governing the application of bit-addressable information to increase the accuracy of the database.

5) Finally, the predetermined parameters that are associated with a discrete case for any given object will have a significant impact upon the ability to accurately process and identify the signals. For example, if a song is transmitted over a FM carrier, then one skilled in the art will appreciate that the FM signal has a predetermined bandwidth which is different from the bandwidth of the original recording, and different even from song when played on an AM carrier, and different yet from a song played using an 8-bit Internet broadcast. Recognition of these differences, however, will permit the selection of an identification means which can be optimized for monitoring a FM broadcasted signal. In other words, the discreteness intended by the sender is limited and directed by the fidelity of the transmission means. Objects may be cataloged and assessing with the understanding that all monitoring will occur using a specific transmission fidelity. For example, a database may be optimized with the understanding that only AM broadcast signals will be monitored. For maximum efficiency, different data bases may be created for different transmission channels, e.g., AM broadcasts, FM broadcasts, Internet broadcasts, etc.

For more information on increasing efficiencies for information systems, see The Mathematical Theory of Communication (1948), by Shannon.

Because bandwidth (which in the digital domain is equated to the total number of bits that can be transmitted in a fixed period of time) is a limited resource which places limitations upon transmission capacity and information coding schemes, the importance of monitoring for information objects transmitted over any given channel must take into consideration the nature and utilization of a given channel. The supply and demand of bandwidth will have a dramatic impact on the transmission, and ultimately, upon the decision to monitor and recognize signals. A discussion of this is found in a application by the inventor under U.S. patent application Ser. No. 08/674,726 (which issued Apr. 22, 2008 as U.S. Pat. No. 7,362,775) "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (which application is incorporated herein by reference as if fully setforth herein).

If a filter is to be used in connection with the recognition or monitoring engine, it may be desirable for the filter to anticipate and take into consideration the following factors, which affect the economics of the transmission as they relate to triggers for payment and/or relate to events requiring audits of the objects which are being transmitted: 1) time of transmission (i.e., the point in time when the transmission occurred), including whether the transmission is of a live performance); 2) location of transmission (e.g., what channel was used for transmission, which usually determines the associated cost for usage of the transmission channel); 3) the point of origination of the transmission (which may be the same for a signal carrier over many distinct channels); and 4) pre-existence of the information carrier signal (pre-recorded or newly created information carrier signal, which may require differentiation in certain markets or instances).

In the case of predetermined carrier signals (those which have been recorded and stored for subsequent use), "positional information carrier signals" are contemplated by this invention, namely, perceptual differences between the seemingly "same" information carrier that can be recognized as consumers of information seek different versions or quality levels of the same carrier signal. Perceptual differences exist between a song and its reproduction from a CD, an AM radio, and an Internet broadcast. To the extent that the creator or consumer of the signal can define a difference in any of the four criteria above, means can be derived (and programmed for selectability) to recognize and distinguish these differences. It is, however, quite possible that the ability to monitor carrier signal transmission with these factors will increase the variety and richness of available carrier signals to existing communications channels. The differentiation between an absolute case for transmission of an object, which is a time dependent event, for instance a live or real time broadcast, versus the relative case, which is prerecorded or stored for transmission at a later point in time, creates recognizable differences for signal monitoring.

The monitoring and analysis contemplated by this invention may have a variety of purposes, including, for example, the following: to determine the number of times a song is broadcast on a particular radio broadcast or Internet site; to control security though a voice-activated security system; and to identify associations between a beginner's drawing and those of great artists (for example to draw comparisons between technique, compositions, or color schemes). None of these examples could be achieved with any significant degree of accuracy using a text-based analysis. Additionally, strictly text-based systems fail to fully capture the inherent value of the data recognition or monitoring information itself.

SAMPLE EMBODIMENTS

Sample Embodiment 1

A database of audio signals (e.g., songs) is stored or maintained by a radio station or

Internet streaming company, who may select a subset of the songs are stored so that the subset may be later broadcast to listeners. The subset, for example, may comprise a sufficient number of songs to fill 24 hours of music programming (between 300 or 500 songs). Traditionally, monitoring is accomplished by embedding some identifier into the signal, or affixing the identifier to the signal, for later analysis and determination of royalty payments. Most of the traditional analysis is performed by actual persons who use play lists and other statistical approximations of audio play, including for example, data obtained through the manual (i.e., by persons) monitoring of a statistically significant sample of stations and transmission times so that an extrapolation may be made to a larger number of comparable markets.

The present invention creates a second database from the first database, wherein each of the stored audio signals in the first database is data reduced in a manner that is not likely to reflect the human perceptual quality of the signal, meaning that a significantly data-reduced signal is not likely to be played back and recognized as the original signal. As a result of the data reduction, the size of the second database (as measured in digital terms) is much smaller than the size of the first database, and is determined by the rate of compression. If, for example, if 24 hours worth of audio signals are compressed at a 10,000:1 compression rate, the reduced data could occupy a little more than 1 megabyte of data. With such a large compression rate, the data to be compared and/or analyzed may become computationally small such that computational speed and efficiency are significantly improved.

With greater compression rates, it is anticipated that similarity may exist between the data compressed abstractions of different analog signals (e.g., recordings by two different artists of the same song). The present invention contemplates the use of bit-addressable differences to distinguish between such cases. In applications where the data to be analyzed has higher value in some predetermined sense, cryptographic protocols, such as a hash or digital signature, can be used to distinguish such close cases.

In a preferred embodiment, the present invention may utilize a centralized database where copies of new recordings may be deposited to ensure that copyright owners, who authorize transmission or use of their recordings by others, can independently verify that the object is correctly monitored. The rules for the creator himself to enter his work would differ from a universally recognized number assigned by an independent authority (say, ISRC, ISBN for recordings and books respectively). Those skilled in the art of algorithmic information theory (AIT) can recognize that it is now possible to describe optimized use of binary data for content and functionality. The differences between objects must relate to decisions made by the user of the data, introducing subjective or cognitive decisions to the design of the contemplated invention as described above. To the extent that objects can have an optimized data size when compared with other objects for any given set of objects, the algorithms for data reduction would have predetermined flexibility directly related to computational efficiency and the set of objects to be monitored. The flexibility in having transparent determination of unique signal abstracts, as opposed to independent third party assignment, is likely to increase confidence in the monitoring effort by the owners of the original signals themselves. The prior art allows for no such transparency to the copyright creators.

Sample Embodiment 2

Another embodiment of the invention relates to visual images, which of course, involve at least two dimensions.

Similar to the goals of a psychoacoustic model, a psychovisual model attempts to represent a visual image with less data, and yet preserve those perceptual qualities that permit a human to recognize the original visual image. Using the very same techniques described above in connection with an audio signal, signal monitoring of visual images may be implemented.

One such application for monitoring and analyzing visual images involves a desire to find works of other artists that relate to a particular theme. For example, finding paintings of sunsets or sunrises. A traditional approach might involve a textual search involving a database wherein the works of other artists have been described in writing. The present invention, however, involves the scanning of an image involving a sun, compressing the data to its essential characteristics (i.e., those perceptual characteristics related to the sun) and then finding matches in a database of other visual images (stored as compressed or even uncompressed data). By studying the work of other artists using such techniques, a novice, for example, could learn much by comparing the presentations of a common theme by different artists.

Another useful application involving this type of monitoring and analyzing is the identification of photographs of potential suspects whose identity matches the sketch of a police artist.

Note that combinations of the monitoring techniques discussed above can be used for audio-visual monitoring, such

as video-transmission by a television station or cable station. The techniques would have to compensate, for example, for a cable station that is broadcasting a audio channel unaccompanied by video.

Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The specification and examples should be considered exemplary only with the true scope and spirit of the invention indicated by the following claims. As will be easily understood by those of ordinary skill in the art, variations and modifications of each of the disclosed embodiments can be easily made within the scope of this invention as defined by the following claims.

The invention claimed is:

1. A system, comprising:

non transitory memory comprising a database for storing a plurality of digital reference signal abstracts;

at least one processor;

wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

wherein said at least one processor is programmed to store said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said non transitory memory further comprises a second database for storing a plurality of second database digital reference signal abstracts;

wherein said at least one processor is programmed or structured to generate a second database digital reference signal abstract from said digital reference signal such that said second database digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal, and wherein said second database digital reference signal abstract is distinct from said digital reference signal abstract; and

wherein said at least one processor is programmed to store said second database digital reference signal abstract in said second database as one of said plurality of second database digital reference signal abstracts.

2. The system of claim **1**, wherein said at least one processor is programmed or structured to generate said digital reference signal abstract from said digital reference signal by using perceptual qualities of said digital reference signal in generating said digital reference signal abstract such that the abstract retains a perceptual relationship to said digital reference signal.

3. The system of claim **1** wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is self similar to said digital reference signal.

4. The system of claim **1**, wherein said at least one processor is programmed or structured to select criteria to use for generating said digital reference signal abstract from said digital reference signal.

5. The system of claim **1**, wherein said at least one processor is programmed or structured to generate said digital query signal abstract from a digital query signal such that said digital query signal abstract is similar to said digital query signal and reduced in size compared to said digital query signal.

6. The system of claim **1**, wherein said at least one processor is programmed to generate said digital reference signal abstract.

7. A system, comprising:

non transitory memory comprising a database for storing a plurality of digital reference signal abstracts;

at least one processor;

wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

wherein said at least one processor is programmed to store said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said at least one processor is programmed or structured to generate said digital reference signal abstract from said digital reference signal and at least one of a hash and a signature, so that each one of said plurality of digital reference signal abstracts in said database is distinct from one another.

8. A system, comprising:

non transitory memory comprising a database for storing a plurality of digital reference signal abstracts;

at least one processor;

wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

wherein said at least one processor is programmed to store said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said digital reference signal is a digital representation of one of a plurality of different versions of a visual work and a multimedia work, and wherein said at least one processor is programmed or structured to generate said digital reference signal abstract from said digital reference signal so that said digital reference signal comprises signal characteristic parameters that differentiate between said plurality of different versions of said visual work and said multimedia work.

9. A system, comprising:

non transitory memory comprising a database for storing a plurality of digital reference signal abstracts;

at least one processor;

wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

wherein said at least one processor is programmed to store said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said at least one processor is programmed or structured to determine if said digital reference signal abstract matches one of said plurality of digital reference signal abstracts stored in said database; and

wherein said processor is programmed to recalibrate said database in response to a determination that said digital reference signal abstract matches one of said plurality of digital reference signal abstracts stored in said database.

10. A system, comprising:

non transitory memory comprising a database for storing a plurality of digital reference signal abstracts;

at least one processor;

wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

wherein said at least one processor is programmed to store said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said processor is programmed or structured to change selected criteria to use for generating said digital reference signal abstract from said digital reference signal when said at least one processor determines that said digital reference signal abstract matches one of said plurality of digital reference signal abstracts stored in said database.

11. A system, comprising:

non transitory memory comprising a database for storing a plurality of digital reference signal abstracts;

at least one processor;

wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

wherein said at least one processor is programmed to store said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said at least one processor is programmed or structured to compare a digital query signal abstract to said plurality of digital reference signal abstracts stored in said database to generate a compare result.

12. The system of claim **11**, wherein said compare result indicates no match between said digital query signal abstract to said plurality of digital reference signal abstracts stored in said database.

13. The system of claim **11**, wherein said compare result indicates a match between said digital query signal abstract and a first digital reference signal abstracts of said plurality of digital reference signal abstracts stored in said database.

14. The system of claim **11**, wherein said memory further defines a digital query signal abstract receipt recorder recording a number times said at least one processor receives said digital query signal abstract for comparison with said plurality of digital reference signal abstracts stored in said database.

15. The system of claim **11**, wherein said memory further defines a first digital reference signal abstract match recorder recording a number of times said at least one processor determines a match between a digital query signal abstract and first digital reference signal abstract of said plurality of digital reference signal abstracts stored in said database.

16. The system of claim **12**, wherein said at least one processor is programmed or structured to use an algorithm to generate said digital reference signal abstract from said digital reference signal; and wherein said at least one processor is programmed or structured to use said algorithm to generate said digital query signal abstract from said digital query signal.

17. A system, comprising:

non transitory memory comprising a database for storing a plurality of digital reference signal abstracts;

at least one processor;

wherein said at least one processor is programmed or structured to generate a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

wherein said at least one processor is programmed to store said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said wherein said at least one processor is programmed or structured to apply at least one of psycho-acoustic model and a psycho-visual model to generate said digital reference signal abstract from said digital reference signal.

18. A method, comprising:

storing in non transitory memory a database for storing a plurality of digital reference signal abstracts;

generating with at least one processor a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

storing with said at least one processor said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said non transitory memory further comprises a second database for storing a plurality of second database digital reference signal abstracts;

wherein said at least one processor is programmed or structured to generate a second database digital reference signal abstract from said digital reference signal such that said second database digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal, and wherein said second database digital reference signal abstract is distinct from said digital reference signal abstract; and

wherein said at least one processor is programmed to store said second database digital reference signal abstract in said second database as one of said plurality of second database digital reference signal abstracts.

19. A computer program product stored on non transitory memory media, which, when installed on a computer system having at least one processor and non transitory memory, causes said computer system to perform the steps comprising:

storing in said non transitory memory a database for storing a plurality of digital reference signal abstracts;

generating with said at least one processor a digital reference signal abstract from a digital reference signal such that said digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal; and

storing with said at least one processor said digital reference signal abstract in said database as one of said plurality of digital reference signal abstracts;

wherein said non transitory memory further comprises a second database for storing a plurality of second database digital reference signal abstracts;

wherein said at least one processor is programmed or structured to generate a second database digital reference signal abstract from said digital reference signal such that said second database digital reference signal abstract is similar to said digital reference signal and reduced in size compared to said digital reference signal, and wherein said second database digital reference signal abstract is distinct from said digital reference signal abstract; and

wherein said at least one processor is programmed to store said second database digital reference signal abstract in said second database as one of said plurality of second database digital reference signal abstracts.

* * * * *

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(12) **United States Patent**
Moskowitz et al.

(10) **Patent No.: US 8,712,728 B2**
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(54) **METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

3,947,825	A		3/1976	Cassada
3,984,624	A		10/1976	Waggener
3,986,624	A		10/1976	Cates, Jr. et al.
4,038,596	A		7/1977	Lee
4,200,770	A		4/1980	Hellman et al.
4,218,582	A		8/1980	Hellman et al.
4,339,134	A		7/1982	Macheel
4,390,898	A		6/1983	Bond et al.
4,405,829	A		9/1983	Rivest et al.
4,424,414	A		1/1984	Hellman et al.
4,528,588	A		7/1985	Lofberg
4,672,605	A		6/1987	Hustig et al.
4,748,668	A		5/1988	Shamir et al.
4,789,928	A		12/1988	Fujisaki
4,827,508	A		5/1989	Shear
4,876,617	A		10/1989	Best et al.
4,896,275	A		1/1990	Jackson
4,908,873	A		3/1990	Philibert et al.
4,939,515	A		7/1990	Adelson
4,969,204	A		11/1990	Melnychuk et al.
4,972,471	A		11/1990	Gross et al.
4,977,594	A		12/1990	Shear
4,979,210	A		12/1990	Nagata et al.
4,980,782	A		12/1990	Ginkel
5,050,213	A		9/1991	Shear
5,073,925	A		12/1991	Nagata et al.
5,077,665	A		12/1991	Silverman et al.
5,111,530	A		5/1992	Kutaragi
5,113,437	A		5/1992	Best et al.
5,123,045	A		6/1992	Ostrovsky
5,136,581	A		8/1992	Muehrcke
5,136,646	A		8/1992	Haber et al.
5,136,647	A		8/1992	Haber et al.
5,142,576	A		8/1992	Nadan
5,161,210	A		11/1992	Druyvesteyn et al.
5,210,820	A	*	5/1993	Kenyon 704/200
5,243,423	A		9/1993	DeJean et al.
5,243,515	A		9/1993	Lee
5,287,407	A		2/1994	Holmes
5,319,735	A		6/1994	Preuss et al.
5,327,520	A		7/1994	Chen

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0372601	6/1990
EP	0565947	10/1993

(Continued)

OTHER PUBLICATIONS

U.S. Appl. No. 11/599,838, filed Nov. 15, 2006.

(Continued)

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(57) **ABSTRACT**

A method and system for monitoring and analyzing at least one signal are disclosed. An abstract of at least one reference signal is generated and stored in a reference database. An abstract of a query signal to be analyzed is then generated so that the abstract of the query signal can be compared to the abstracts stored in the reference database for a match. The method and system may optionally be used to record information about the query signals, the number of matches recorded, and other useful information about the query signals. Moreover, the method by which abstracts are generated can be programmable based upon selectable criteria. The system can also be programmed with error control software so as to avoid the re-occurrence of a query signal that matches more than one signal stored in the reference database.

31 Claims, No Drawings

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,341,429	A	8/1994	Stringer et al.	
5,341,477	A	8/1994	Pitkin et al.	
5,363,448	A	11/1994	Koopman et al.	
5,365,586	A	11/1994	Indeck et al.	
5,369,707	A	11/1994	Follendore, III	
5,379,345	A	1/1995	Greenberg	
5,394,324	A	2/1995	Clearwater	
5,398,285	A	3/1995	Borgelt et al.	
5,406,627	A	4/1995	Thompson et al.	
5,408,505	A	4/1995	Indeck et al.	
5,410,598	A	4/1995	Shear	
5,412,718	A	5/1995	Narasimhalv et al.	
5,418,713	A	5/1995	Allen	
5,428,606	A	6/1995	Moskowitz	
5,437,050	A	7/1995	Lamb	
5,450,490	A	9/1995	Jensen et al.	
5,469,536	A	11/1995	Blank	
5,471,533	A	11/1995	Wang et al.	
5,478,990	A	12/1995	Montanari et al.	
5,479,210	A	12/1995	Cawley et al.	
5,487,168	A	1/1996	Geiner et al.	
5,493,677	A	2/1996	Balogh et al.	
5,497,419	A	3/1996	Hill	
5,506,795	A	4/1996	Yamakawa	
5,513,126	A	4/1996	Harkins et al.	
5,513,261	A	4/1996	Maher	
5,530,739	A	6/1996	Okada	
5,530,751	A	6/1996	Morris	
5,530,759	A	6/1996	Braudaway et al.	
5,539,735	A	7/1996	Moskowitz	
5,548,579	A	8/1996	Lebrun et al.	
5,568,570	A	10/1996	Rabbani	
5,579,124	A	11/1996	Aijala et al.	
5,581,703	A	12/1996	Baugher et al.	
5,583,488	A	12/1996	Sala et al.	
5,598,470	A	1/1997	Cooper et al.	
5,606,609	A	2/1997	Houser et al.	
5,613,004	A	3/1997	Cooperman et al.	
5,617,119	A	4/1997	Briggs et al.	
5,617,506	A	4/1997	Burk	
5,625,690	A	4/1997	Michel et al.	
5,629,980	A	5/1997	Stefik et al.	
5,633,932	A	5/1997	Davis et al.	
5,634,040	A	5/1997	Her et al.	
5,636,276	A	6/1997	Brugger	
5,636,292	A	6/1997	Rhoads	
5,640,569	A	6/1997	Miller et al.	
5,646,997	A	7/1997	Barton	
5,649,284	A *	7/1997	Yoshinobu	725/114
5,657,461	A	8/1997	Harkins et al.	
5,659,726	A	8/1997	Sandford, II et al.	
5,664,018	A	9/1997	Leighton	
5,673,316	A	9/1997	Auerbach et al.	
5,675,653	A	10/1997	Nelson	
5,677,952	A	10/1997	Blakley et al.	
5,680,462	A	10/1997	Miller et al.	
5,687,236	A	11/1997	Moskowitz et al.	
5,689,587	A	11/1997	Bender et al.	
5,696,828	A	12/1997	Koopman, Jr.	
5,719,937	A	2/1998	Warren et al.	
5,721,788	A	2/1998	Powell et al.	
5,734,752	A	3/1998	Knox	
5,737,416	A	4/1998	Cooper et al.	
5,737,733	A	4/1998	Eller	
5,740,244	A	4/1998	Indeck et al.	
5,745,569	A	4/1998	Moskowitz et al.	
5,748,783	A	5/1998	Rhoads	
5,751,811	A	5/1998	Magnotti et al.	
5,754,697	A	5/1998	Fu et al.	
5,754,938	A	5/1998	Herz	
5,757,923	A	5/1998	Koopman, Jr.	
5,765,152	A	6/1998	Erickson	
5,768,396	A	6/1998	Sone	
5,774,452	A	6/1998	Wolosewicz	
5,781,184	A	7/1998	Wasserman	
5,790,677	A	8/1998	Fox et al.	
5,799,083	A	8/1998	Brothers et al.	
5,809,139	A	9/1998	Girod et al.	
5,809,160	A	9/1998	Powell et al.	
5,818,818	A	10/1998	Soumiya	
5,822,432	A	10/1998	Moskowitz et al.	
5,828,325	A	10/1998	Wolosewicz et al.	
5,832,119	A	11/1998	Rhoads	
5,839,100	A	11/1998	Wegener	
5,842,213	A	11/1998	Odom	
5,848,155	A	12/1998	Cox	
5,850,481	A	12/1998	Rhoads	
5,859,920	A	1/1999	Daly et al.	
5,860,099	A	1/1999	Milios et al.	
5,862,260	A	1/1999	Rhoads	
5,870,474	A	2/1999	Wasilewski et al.	
5,884,033	A	3/1999	Duvall et al.	
5,889,868	A	3/1999	Moskowitz et al.	
5,893,067	A	4/1999	Bender et al.	
5,894,521	A	4/1999	Conley	
5,901,178	A	5/1999	Lee	
5,903,721	A	5/1999	Sixtus	
5,905,800	A	5/1999	Moskowitz et al.	
5,905,975	A	5/1999	Ausubel	
5,912,972	A	6/1999	Barton	
5,915,027	A	6/1999	Cox et al.	
5,917,915	A	6/1999	Hirose	
5,918,223	A	6/1999	Blum	
5,920,900	A	7/1999	Poole et al.	
5,923,763	A	7/1999	Walker et al.	
5,930,369	A	7/1999	Cox et al.	
5,930,377	A	7/1999	Powell et al.	
5,940,134	A	8/1999	Wirtz	
5,943,422	A	8/1999	Van Wie et al.	
5,949,055	A	9/1999	Fleet	
5,949,973	A	9/1999	Yarom	
5,963,909	A	10/1999	Warren et al.	
5,973,731	A	10/1999	Schwab	
5,974,141	A	10/1999	Saito	
5,991,426	A	11/1999	Cox et al.	
5,999,217	A	12/1999	Berners-Lee	
6,009,176	A	12/1999	Gennaro et al.	
6,029,126	A	2/2000	Malvar	
6,035,398	A	3/2000	Bjorn	
6,041,316	A	3/2000	Allen	
6,044,471	A	3/2000	Colvin	
6,049,838	A	4/2000	Miller et al.	
6,051,029	A	4/2000	Paterson et al.	
6,061,793	A	5/2000	Tewfik et al.	
6,067,622	A	5/2000	Moore	
6,069,914	A	5/2000	Cox	
6,078,664	A	6/2000	Moskowitz et al.	
6,081,251	A	6/2000	Sakai et al.	
6,081,587	A	6/2000	Reyes et al.	
6,081,597	A	6/2000	Hoffstein	
6,088,455	A *	7/2000	Logan et al.	380/200
6,131,162	A	10/2000	Yoshiura et al.	
6,141,753	A	10/2000	Zhao et al.	
6,141,754	A	10/2000	Choy	
6,148,333	A	11/2000	Guedalia	
6,154,571	A	11/2000	Cox et al.	
6,173,322	B1	1/2001	Hu	
6,178,405	B1	1/2001	Ouyang	
6,192,138	B1	2/2001	Yamadaji	
6,199,058	B1	3/2001	Wong et al.	
6,205,249	B1	3/2001	Moskowitz	
6,208,745	B1	3/2001	Florenio et al.	
6,226,618	B1	5/2001	Downs	
6,230,268	B1	5/2001	Miwa et al.	
6,233,347	B1	5/2001	Chen et al.	
6,233,684	B1	5/2001	Stefik et al.	
6,240,121	B1	5/2001	Senoh	
6,263,313	B1	7/2001	Milsted et al.	
6,272,634	B1	8/2001	Tewfik et al.	
6,275,988	B1	8/2001	Nagashima et al.	
6,278,780	B1	8/2001	Shimada	
6,278,791	B1	8/2001	Honsinger et al.	
6,282,300	B1	8/2001	Bloom et al.	
6,282,650	B1	8/2001	Davis	

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,285,775	B1	9/2001	Wu et al.
6,301,663	B1	10/2001	Kato et al.
6,310,962	B1	10/2001	Chung et al.
6,330,335	B1	12/2001	Rhoads
6,330,672	B1	12/2001	Shur
6,345,100	B1	2/2002	Levine
6,351,765	B1	2/2002	Pietropaolo et al.
6,363,483	B1	3/2002	Keshav
6,373,892	B1	4/2002	Ichien et al.
6,373,960	B1	4/2002	Conover et al.
6,374,036	B1	4/2002	Ryan et al.
6,377,625	B1	4/2002	Kim
6,381,618	B1	4/2002	Jones et al.
6,381,747	B1	4/2002	Wonfor et al.
6,385,324	B1	5/2002	Koppen
6,385,329	B1	5/2002	Sharma et al.
6,385,596	B1	5/2002	Wiser
6,389,538	B1	5/2002	Gruse et al.
6,398,245	B1	6/2002	Gruse
6,405,203	B1	6/2002	Collart
6,415,041	B1	7/2002	Oami et al.
6,418,421	B1	7/2002	Hurtado
6,425,081	B1	7/2002	Iwamura
6,430,301	B1	8/2002	Petrovic
6,430,302	B2	8/2002	Rhoads
6,442,283	B1	8/2002	Tewfik et al.
6,446,211	B1	9/2002	Colvin
6,453,252	B1	9/2002	Laroche
6,457,058	B1	9/2002	Ullum et al.
6,463,468	B1	10/2002	Buch et al.
6,480,937	B1	11/2002	Vorbach
6,484,264	B1	11/2002	Colvin
6,493,457	B1	12/2002	Quackenbush
6,502,195	B1	12/2002	Colvin
6,522,767	B1	2/2003	Moskowitz et al.
6,522,769	B1	2/2003	Rhoads et al.
6,523,113	B1	2/2003	Wehrenberg
6,530,021	B1	3/2003	Epstein et al.
6,532,284	B2	3/2003	Walker et al.
6,539,475	B1	3/2003	Cox et al.
6,557,103	B1	4/2003	Boncelet, Jr. et al.
6,584,125	B1	6/2003	Katto
6,587,837	B1	7/2003	Spagna et al.
6,590,996	B1	7/2003	Reed
6,598,162	B1	7/2003	Moskowitz
6,606,393	B1	8/2003	Xie et al.
6,611,599	B2	8/2003	Natarajan
6,647,424	B1	11/2003	Pearson et al.
6,658,010	B1	12/2003	Enns et al.
6,665,489	B2	12/2003	Collart
6,668,246	B1	12/2003	Yeung et al.
6,668,325	B1	12/2003	Collberg et al.
6,674,858	B1	1/2004	Kimura
6,687,683	B1	2/2004	Harada et al.
6,725,372	B1	4/2004	Lewis et al.
6,754,822	B1	6/2004	Zhao
6,775,772	B1	8/2004	Binding et al.
6,784,354	B1	8/2004	Lu et al.
6,785,815	B1	8/2004	Serret-Avila et al.
6,785,825	B2	8/2004	Colvin
6,792,548	B2	9/2004	Colvin
6,792,549	B2	9/2004	Colvin
6,795,925	B2	9/2004	Colvin
6,799,277	B2	9/2004	Colvin
6,804,453	B1	10/2004	Sasamoto
6,813,717	B2	11/2004	Colvin
6,813,718	B2	11/2004	Colvin
6,823,455	B1	11/2004	Macy et al.
6,834,308	B1	12/2004	Ikezoye et al.
6,842,862	B2	1/2005	Chow et al.
6,853,726	B1	2/2005	Moskowitz et al.
6,857,078	B2	2/2005	Colvin
6,865,747	B1	3/2005	Mercier
6,931,534	B1	8/2005	Jandel et al.
6,950,941	B1	9/2005	Lee
6,957,330	B1	10/2005	Hughes
6,966,002	B1	11/2005	Torrubia-Saez
6,977,894	B1	12/2005	Achilles et al.
6,978,370	B1	12/2005	Kocher
6,983,058	B1	1/2006	Fukuoka
6,983,337	B2	1/2006	Diamant
6,986,063	B2	1/2006	Colvin
6,990,453	B2	1/2006	Wang
7,007,166	B1	2/2006	Moskowitz et al.
7,020,285	B1	3/2006	Kirovski et al.
7,035,049	B2	4/2006	Yamamoto
7,035,409	B1	4/2006	Moskowitz
7,043,050	B2	5/2006	Yuval
7,046,808	B1	5/2006	Metois et al.
7,050,396	B1	5/2006	Cohen et al.
7,051,208	B2	5/2006	Venkatesan et al.
7,058,570	B1	6/2006	Yu et al.
7,093,295	B1	8/2006	Saito
7,095,715	B2	8/2006	Buckman
7,095,874	B2	8/2006	Moskowitz et al.
7,103,184	B2	9/2006	Jian
7,107,451	B2	9/2006	Moskowitz
7,123,718	B1	10/2006	Moskowitz et al.
7,127,615	B2	10/2006	Moskowitz
7,150,003	B2	12/2006	Naumovich et al.
7,152,162	B2	12/2006	Moskowitz et al.
7,159,116	B2	1/2007	Moskowitz
7,162,642	B2	1/2007	Schumann et al.
7,177,429	B2	2/2007	Moskowitz et al.
7,177,430	B2	2/2007	Kim
7,206,649	B2	4/2007	Kirovski et al.
7,231,524	B2	6/2007	Burns
7,233,669	B2	6/2007	Candelore
7,240,210	B2	7/2007	Michak et al.
7,266,697	B2	9/2007	Kirovski et al.
7,286,451	B2	10/2007	Wirtz
7,287,275	B2	10/2007	Moskowitz
7,289,643	B2	10/2007	Brunk et al.
7,310,815	B2	12/2007	Yanovsky
7,343,492	B2	3/2008	Moskowitz et al.
7,346,472	B1	3/2008	Moskowitz et al.
7,362,775	B1	4/2008	Moskowitz
7,363,278	B2	4/2008	Schmelzer et al.
7,409,073	B2	8/2008	Moskowitz et al.
7,457,962	B2	11/2008	Moskowitz
7,460,994	B2	12/2008	Herre et al.
7,475,246	B1	1/2009	Moskowitz
7,530,102	B2	5/2009	Moskowitz
7,532,725	B2	5/2009	Moskowitz et al.
7,568,100	B1	7/2009	Moskowitz et al.
7,630,379	B2	12/2009	Morishita
7,647,502	B2	1/2010	Moskowitz
7,647,503	B2	1/2010	Moskowitz
7,664,263	B2	2/2010	Moskowitz
7,719,966	B2	5/2010	Luft
7,743,001	B1	6/2010	Vermeulen
7,761,712	B2	7/2010	Moskowitz
7,779,261	B2	8/2010	Moskowitz
8,121,343	B2	2/2012	Moskowitz
8,161,286	B2	4/2012	Moskowitz
8,179,846	B2	5/2012	Dolganow
8,214,175	B2	7/2012	Moskowitz
8,265,278	B2	9/2012	Moskowitz
8,307,213	B2	11/2012	Moskowitz
8,400,566	B2	3/2013	Terry
2001/0010078	A1	7/2001	Moskowitz
2001/0029580	A1	10/2001	Moskowitz
2001/0043594	A1*	11/2001	Ogawa et al. 370/356
2002/0009208	A1	1/2002	Alattar
2002/0010684	A1	1/2002	Moskowitz
2002/0026343	A1	2/2002	Duenke
2002/0047873	A1	4/2002	Imanaka et al.
2002/0056041	A1	5/2002	Moskowitz
2002/0057651	A1	5/2002	Roberts
2002/0071556	A1	6/2002	Moskowitz et al.
2002/0073043	A1	6/2002	Herman et al.
2002/0097873	A1	7/2002	Petrovic
2002/0103883	A1	8/2002	Haverstock et al.
2002/0152179	A1	10/2002	Racov

(56) **References Cited**

U.S. PATENT DOCUMENTS

2002/0161741	A1	10/2002	Wang et al.
2003/0002862	A1	1/2003	Rodriguez
2003/0005780	A1	1/2003	Pahl
2003/0023852	A1	1/2003	Wold
2003/0027549	A1	2/2003	Kiel
2003/0033321	A1	2/2003	Schrempp
2003/0126445	A1	7/2003	Wehrenberg
2003/0133702	A1	7/2003	Collart
2003/0200439	A1	10/2003	Moskowitz
2003/0219143	A1	11/2003	Moskowitz et al.
2004/0028222	A1	2/2004	Sewell et al.
2004/0037449	A1	2/2004	Davis et al.
2004/0049695	A1	3/2004	Choi et al.
2004/0059918	A1	3/2004	Xu
2004/0083369	A1	4/2004	Erlingsson et al.
2004/0086119	A1	5/2004	Moskowitz
2004/0093521	A1	5/2004	Hamadeh et al.
2004/0117628	A1	6/2004	Colvin
2004/0117664	A1	6/2004	Colvin
2004/0125983	A1	7/2004	Reed et al.
2004/0128514	A1	7/2004	Rhoads
2004/0225894	A1	11/2004	Colvin
2004/0243540	A1	12/2004	Moskowitz et al.
2005/0135615	A1	6/2005	Moskowitz et al.
2005/0160271	A9	7/2005	Brundage et al.
2005/0177727	A1	8/2005	Moskowitz et al.
2005/0246554	A1	11/2005	Batson
2006/0005029	A1	1/2006	Petrovic et al.
2006/0013395	A1	1/2006	Brundage et al.
2006/0013451	A1	1/2006	Haitsma
2006/0041753	A1	2/2006	Haitsma
2006/0101269	A1	5/2006	Moskowitz et al.
2006/0140403	A1	6/2006	Moskowitz
2006/0251291	A1	11/2006	Rhoads
2006/0285722	A1	12/2006	Moskowitz et al.
2007/0011458	A1	1/2007	Moskowitz
2007/0028113	A1	2/2007	Moskowitz
2007/0064940	A1	3/2007	Moskowitz et al.
2007/0079131	A1	4/2007	Moskowitz et al.
2007/0083467	A1	4/2007	Lindahl et al.
2007/0110240	A1	5/2007	Moskowitz et al.
2007/0113094	A1	5/2007	Moskowitz et al.
2007/0127717	A1	6/2007	Herre et al.
2007/0226506	A1	9/2007	Moskowitz
2007/0253594	A1	11/2007	Lu et al.
2007/0294536	A1	12/2007	Moskowitz et al.
2007/0300072	A1	12/2007	Moskowitz
2007/0300073	A1	12/2007	Moskowitz
2008/0005571	A1	1/2008	Moskowitz
2008/0005572	A1	1/2008	Moskowitz
2008/0016365	A1	1/2008	Moskowitz
2008/0022113	A1	1/2008	Moskowitz
2008/0022114	A1	1/2008	Moskowitz
2008/0028222	A1	1/2008	Moskowitz
2008/0046742	A1	2/2008	Moskowitz
2008/0075277	A1	3/2008	Moskowitz et al.
2008/0109417	A1	5/2008	Moskowitz
2008/0133927	A1	6/2008	Moskowitz et al.
2008/0151934	A1	6/2008	Moskowitz et al.
2009/0037740	A1	2/2009	Moskowitz
2009/0089427	A1	4/2009	Moskowitz et al.
2009/0190754	A1	7/2009	Moskowitz et al.
2009/0210711	A1	8/2009	Moskowitz
2009/0220074	A1	9/2009	Moskowitz et al.
2010/0002904	A1	1/2010	Moskowitz
2010/0005308	A1	1/2010	Moskowitz
2010/0064140	A1	3/2010	Moskowitz
2010/0077219	A1	3/2010	Moskowitz
2010/0077220	A1	3/2010	Moskowitz
2010/0098251	A1	4/2010	Moskowitz
2010/0106736	A1	4/2010	Moskowitz
2010/0153734	A1	6/2010	Moskowitz
2010/0182570	A1	7/2010	Matsumoto et al.
2010/0202607	A1	8/2010	Moskowitz
2010/0220861	A1	9/2010	Moskowitz
2010/0313033	A1	12/2010	Moskowitz
2011/0019691	A1	1/2011	Moskowitz
2011/0069864	A1	3/2011	Moskowitz
2011/0128445	A1	6/2011	Carrieres
2012/0057012	A1	3/2012	Sitrick
2013/0145058	A1	6/2013	Shuholm

FOREIGN PATENT DOCUMENTS

EP	0581317		2/1994
EP	0581317	A2	2/1994
EP	0649261		4/1995
EP	0651554		5/1995
EP	0872073		7/1996
EP	1547337		3/2006
EP	1354276		12/2007
NL	1005523		9/1998
WO	WO 9514289		5/1995
WO	WO 9629795		9/1996
WO	WO 9642151		12/1996
WO	WO9701892		1/1997
WO	WO9726733		1/1997
WO	WO 9724833		7/1997
WO	WO9726732		7/1997
WO	WO 9744736		11/1997
WO	WO9802864		1/1998
WO	WO9802864		7/1998
WO	WO9837513		8/1998
WO	WO 9952271		10/1999
WO	WO 9962044		12/1999
WO	WO 9963443		12/1999
WO	WO 0057643		9/2000
WO	WO0118628		3/2001
WO	WO0143026		6/2001
WO	WO0203385		1/2002
WO	WO02003385	A1	10/2002

OTHER PUBLICATIONS

U.S. Appl. No. 11/899,662, filed Sep. 7, 2007.
U.S. Appl. No. 10/369,344, filed Feb. 18, 2003.
U.S. Appl. No. 11/482,654, filed Jul. 7, 2006.
U.S. Appl. No. 12/215,812, filed Jun. 30, 2008.
U.S. Appl. No. 12/901,568, filed Oct. 10, 2010.
U.S. Appl. No. 11/497,822, filed Aug. 2, 2006.
U.S. Appl. No. 12/217,834, filed Jul. 9, 2008.
U.S. Appl. No. 11/897,790, filed Aug. 31, 2007.
U.S. Appl. No. 12/462,799, filed Aug. 10, 2009.
U.S. Appl. No. 11/899,661, filed Sep. 7, 2007.
U.S. Appl. No. 12/590,681, filed Nov. 19, 2009.
U.S. Appl. No. 11/897,791, filed Aug. 31, 2007.
U.S. Appl. No. 12/590,553, filed Nov. 10, 2009.
U.S. Appl. No. 12/592,331, filed Nov. 23, 2009.
U.S. Appl. No. 11/599,964, filed Nov. 15, 2006.
U.S. Appl. No. 13/212,264, filed Aug. 18, 2011.
U.S. Appl. No. 08/674,726, filed Jul. 2, 1996.
U.S. Appl. No. 09/545,589, filed Apr. 7, 2000.
U.S. Appl. No. 11/244,213, filed Oct. 5, 2005.
U.S. Appl. No. 12/009,914, filed Jan. 23, 2008.
U.S. Appl. No. 12/005,230, filed Dec. 26, 2007.
U.S. Appl. No. 12/803,168, filed Jun. 21, 2010.
U.S. Appl. No. 11/649,026, filed Jan. 3, 2007.
U.S. Appl. No. 12/803,194, filed Jun. 21, 2010.
U.S. Appl. No. 12/892,900, filed Sep. 28, 2010.
U.S. Appl. No. 08/489,172, filed Jun. 7, 1995.
U.S. Appl. No. 08/775,216, filed Dec. 31, 1996.
U.S. Appl. No. 08/999,766, filed Jul. 23, 1997.
U.S. Appl. No. 11/894,476, filed Aug. 21, 2007.
U.S. Appl. No. 11/050,779, filed Feb. 7, 2005.
U.S. Appl. No. 12/802,519, filed Jun. 8, 2010.
U.S. Appl. No. 12/383,916, filed Mar. 30, 2009.
U.S. Appl. No. 11/894,443, filed Aug. 21, 2007.
U.S. Appl. No. 12/913,751, filed Oct. 27, 2010.
U.S. Appl. No. 13/803,889, filed Mar. 14, 2013.
U.S. Appl. No. 08/587,943, filed Jan. 17, 1996.
U.S. Appl. No. 09/046,627, filed Mar. 24, 1998.

(56) **References Cited**

OTHER PUBLICATIONS

U.S. Appl. No. 10/602,777, filed Jun. 25, 2003.
U.S. Appl. No. 11/512,701, filed Aug. 29, 2006.
U.S. Appl. No. 11/895,388, filed Aug. 24, 2007.
U.S. Appl. No. 12/655,002, filed Dec. 22, 2009.
U.S. Appl. No. 13/556,420, filed Jul. 24, 2012.
U.S. Appl. No. 13/794,584, filed Mar. 12, 2013.
U.S. Appl. No. 09/731,039, filed Dec. 7, 2000.
U.S. Appl. No. 11/647,861, filed Dec. 29, 2006.
U.S. Appl. No. 12/383,879, filed Mar. 30, 2009.
U.S. Appl. No. 12/886,732, filed Sep. 21, 2010.
U.S. Appl. No. 13/572,641, filed Aug. 11, 2012.
U.S. Appl. No. 13/794,742, filed Mar. 12, 2013.
U.S. Appl. No. 10/049,101, filed Jul. 23, 2002.
U.S. Appl. No. 12/287,443, filed Oct. 9, 2008.
U.S. Appl. No. 13/413,691, filed Mar. 7, 2012.
U.S. Appl. No. 13/796,538, filed Mar. 12, 2013.
U.S. Appl. No. 09/657,181, filed Sep. 7, 2000.
U.S. Appl. No. 12/005,229, filed Dec. 26, 2007.
U.S. Appl. No. 12/655,357, filed Dec. 22, 2009.
U.S. Appl. No. 13/035,964, filed Feb. 26, 2011.
U.S. Appl. No. 13/487,119, filed Jun. 1, 2012.
U.S. Appl. No. 13/802,384, filed Mar. 13, 2013.
U.S. Appl. No. 10/417,231, filed Apr. 17, 2003.
U.S. Appl. No. 11/900,065, filed Sep. 10, 2007.
U.S. Appl. No. 11/900,066, filed Sep. 10, 2007.
U.S. Appl. No. 12/383,289, filed Mar. 23, 2009.
U.S. Appl. No. 13/273,930, filed Oct. 14, 2011.
U.S. Appl. No. 13/551,097, filed Jul. 17, 2012.
U.S. Appl. No. 13/488,357, filed Jun. 4, 2012.
U.S. Appl. No. 13/488,395, filed Jun. 4, 2012.
U.S. Appl. No. 09/053,628, filed Apr. 2, 1998.
U.S. Appl. No. 09/644,098, filed Aug. 23, 2000.
U.S. Appl. No. 11/358,874, filed Feb. 21, 2006.
U.S. Appl. No. 12/799,894, filed May 4, 2010.
U.S. Appl. No. 09/731,040, filed Dec. 7, 2000.
U.S. Appl. No. 13/826,858, filed Mar. 14, 2013.
U.S. Appl. No. 13/797,744, filed Mar. 12, 2013.
U.S. Appl. No. 09/594,719, filed Jun. 16, 2000.
U.S. Appl. No. 11/519,467, filed Sep. 12, 2006.
U.S. Appl. No. 12/655,036, filed Dec. 22, 2009.
U.S. Appl. No. 13/423,650, filed Mar. 19, 2012.
U.S. Appl. No. 13/802,471, filed Mar. 13, 2013.
U.S. Appl. No. 08/772,222, filed Dec. 20, 1996.
U.S. Appl. No. 09/456,319, filed Dec. 8, 1999.
U.S. Appl. No. 11/826,234, filed Dec. 30, 2004.
U.S. Appl. No. 11/592,879, filed Nov. 2, 2006.
U.S. Appl. No. 12/798,959, filed Apr. 14, 2010.
U.S. Appl. No. 11/518,806, filed Sep. 11, 2006.
U.S. Appl. No. 13/429,396, filed Mar. 25, 2012.
U.S. Appl. No. 61/794,141, filed Mar. 15, 2013.
SonicWall, Inc., 2008 "The Advantages of a Multi-core Architecture in Network Security Appliances" http://www.sonicwall.com/downloads/WP-ENG-010_Multicore . . . .
Voip-Pal.Com Inc's Lawful Intercept Patent Application Receives the Allowance for Issuance as a Patent, http://finance.yahoo.com/news/voip-pal-com-inc-lawful-133000133.html, 2013.
Deep Content Inspection—Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/Deep_content_inspection (last visited Apr. 4, 2013).
Dexter, et. al, "Multi-view Synchronization of Human Actions and Dynamic Scenes" pp. 1-11, 2009.
Kudrle, et al., "Fingerprinting for Solving A/V Synchronization Issues within Broadcast Environments", 2011.
Junego, et. al., "View-Independent Action Recognition from Temporal Self-Similarities", 2011, 2010.
Dexter, et al., "Multi-view Synchronization of Image Sequences", 2009.
Blue Spike, LLC. v. *Texas Instruments, Inc et. al,* (No. 6:12-CV-499-MHS), Audible Magic Corporations's amended Answer(E.D. TX filed Jul. 15, 2013) (Document 885 p. ID) 9581), (PACER).
U.S. Appl. No. 08/999,766, filed Jul. 23, 1997, entitled "Steganographic Method and Device", published as 7568100 Jul. 28, 2009, cited as U280.
EPO Application No. 96919405.9, entitled "Steganographic Method and Device"; published as EP0872073 (A2), Oct. 21, 1998, cited herein as F20.
U.S. Appl. No. 11/050,779, filed Feb. 7, 2005, entitled "Steganographic Method and Device", published as 20050177727 A1 Aug. 11, 2005, cited herein as P30.
U.S. Appl. No. 08/674,726, filed Jul. 2, 1996, entitled "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management", published as 7362775 Apr. 22, 2008, cited herein as U272.
U.S. Appl. No. 09/545,589, filed Apr. 7, 2000, entitled "Method and System for Digital Watermarking", published as 7007166 Feb. 28, 2006, cited herein as U243.
U.S. Appl. No. 11/244,213, filed Oct. 5, 2005, entitled "Method and System for Digital Watermarking", published as 2006-0101269 A1 May 11, 2006, cited herein as P36.
U.S. Appl. No. 11/649,026, filed Jan. 3, 2007, entitled "Method and System for Digital Watermarking", published as 2007-0113094 A1 May 17, 2007, cited herein as P45.
U.S. Appl. No. 09/046,627, filed Mar. 24, 1998, entitled "Method for Combining Transfer Function with Predetermined Key Creation", published as 6,598,162 Jul. 22, 2003, cited herein as U212.
U.S. Appl. No. 10/602,777, filed Jun. 25, 2003, entitled "Method for Combining Transfer Function with Predetermined Key Creation", published as 2004-0086119 A1 May 6, 2004, cited herein P20.
U.S. Appl. No. 09/053,628, filed Apr. 2, 1998, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", 6,205,249 Mar. 20, 2001, cited herein as U161.
U.S. Appl. No. 09/644,098, filed Aug. 23, 2000, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", published as 7,035,409 Apr. 25, 2006, cited herein as U245.
Jap. App. No. 2000-542907, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking"; which is a JP national stage of PCT/US1999/007262, published as WO/1999/052271, Oct. 14, 1999, F13 here in above.
U.S. Appl. No. 09/767,733, filed Jan. 24, 2001 entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", published as 2001-0010078 A1 Jul. 26, 2001, cited herein as P1.
U.S. Appl. No. 11/358,874, filed Feb. 21, 2006, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking", published as 2006-0140403 A1 Jun. 29, 2006, cited herein as P37.
U.S. Appl. No. 10/417,231, filed Apr. 17, 2003, entitled "Methods, Systems and Devices for Packet Watermarking and Efficient Provisioning of Bandwidth", published as 2003-0200439 A1 Oct. 23, 2003, cited herein as P13.
U.S. Appl. No. 09/789,711, filed Feb. 22, 2001, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2001-0029580 A1 Oct. 11, 2001, cited herein as P75.
U.S. Appl. No. 11/497,822, filed Aug. 2, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2007-0011458 A1 Jan. 11, 2007, cited herein as P39.
U.S. Appl. No. 11/599,964, filed Nov. 15, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2008-0046742 A1 Feb. 21, 2008, cited herein as P58.
U.S. Appl. No. 11/599,838, filed Nov. 15, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 2007-0226506 A1 Sep. 27, 2007, cited herein as P47.

(56) **References Cited**

OTHER PUBLICATIONS

U.S. Appl. No. 10/369,344, filed Feb. 18, 2003, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data", published as 2003-0219143 A1 Nov. 27, 2003, cited herein as P14.

U.S. Appl. No. 11/482,654, filed Jul. 7, 2006, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data", published as 2006-0285722 A1 Dec. 21, 2006, cited herein as P38.

U.S. Appl. No. 09/594,719, filed Jun. 16, 2000, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as 7,123,718 Oct. 17, 2006, cited herein as U255.

U.S. Appl. No. 11/519,467, filed Sep. 12, 2006, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as 2007-0064940 A1 Mar. 22, 2007, cited herein as P41.

U.S. Appl. No. 09/731,040, filed Dec. 7, 2000, entitled "Systems, Methods and Devices for Trusted Transactions", 2002-0010684 A1 Jan. 24, 2002, cited herein as P3.

U.S. Appl. No. 11/512,701, filed Aug. 29, 2006, entitled "Systems, Methods and Devices for Trusted Transactions", published as 2007-0028113 A1 Feb. 1, 2007, cited herein as P40.

U.S. Appl. No. 10/049,101, filed Feb. 8, 2002, entitled "A Secure Personal Content Server", published as 7,475,246 Jan. 6, 2009, cited herein as U277.

PCT Application No. PCT/US00/21189, filed Aug. 4, 2000, entitled, "A Secure Personal Content Server", Pub. No. WO/2001/018628 ; Publication Date: Mar. 15, 2001, cited herein as F21.

U.S. Appl. No. 09/657,181, filed Sep. 7, 2000, entitled "Method and Device for Monitoring and Analyzing Signals", published as 7,346,472 Mar. 18, 2008, cited herein as U271.

U.S. Appl. No. 10/805,484, filed Mar. 22, 2004, entitled "Method and Device for Monitoring and Analyzing Signals", published as 2004-0243540 A1 Dec. 2, 2004, cited herein as P27.

U.S. Appl. No. 09/956,262, filed Sep. 20, 2001, entitled "Improved Security Based on Subliminal and Supraliminal Channels for Data Objects", published as 2002-0056041 A1 May 9, 2002, cited herein as P05.

U.S. Appl. No. 11/518,806, filed Sep. 11, 2006, entitled "Improved Security Based on Subliminal and Supraliminal Channels for Data Objects", 2008-0028222 A1 Jan. 31, 2008, cited herein as P57.

U.S. Appl. No. 11/026,234, filed Dec. 30, 2004, entitled "Z-Transform Implementation of Digital Watermarks" , published as 2005-0135615 A1 Jun. 23, 2005, cited herein as P28.

U.S. Appl. No. 11/592,079, filed Nov. 2, 2006, entitled "Linear Predictive Coding Implementation of Digital Watermarks", published as 2007-0079131 A1 Apr. 5, 2007, cited herein as P42.

U.S. Appl. No. 09/731,039, filed Dec. 7, 2000, entitled "System and Methods for Permitting Open Access to Data Objects and for Securing Data within the Data Objects", published as 2002-0071556 A1 Jun. 13, 2002, cited herein as P06.

U.S. Appl. No. 11/647,861, filed Dec. 29, 2006, entitled "System and Methods for Permitting Open Access to Data Objects and for Securing Data within the Data Objects", published as 2007-0110240 A1 May 17, 2007, cited herein as P44.

Schneier, Bruce, Applied Cryptography, 2nd Ed., John Wiley & Sons, pp. 9-10, 1996.

Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 46, 1997.

Merriam-Webster's Collegiate Dictionary, 10th Ed., Merriam Webster, Inc., p. 207, 1997.

Brealy, et al., Principles of Corporate Finance, "Appendix A—Using Option Valuation Models", 1984, pp. 448-449.

Copeland, et al., Real Options: A Practitioner's Guide, 2001 pp. 106-107, 201-202, 204-208.

Sarkar, M. "An Assessment of Pricing Mechanisms for the Internet-A Regulatory Imperative", presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/iep/works/SarkAsses.html on.

Crawford, D.W. "Pricing Network Usage: A Market for Bandwidth of Market Communication?" presented MIT Workshop on Internet Economics, Mar. 1995 http://www.press.vmich.edu/iep/works/CrawMarket.html on March.

Low, S.H., "Equilibrium Allocation and Pricing of Variable Resources Among User-Suppliers", 1988. http://www.citesear.nj.nec.com/366503.html.

Caronni, Germano, "Assuring Ownership Rights for Digital Images", published proceeds of reliable IT systems, v15 '95, H.H. Bruggemann and W. Gerhardt-Hackel (Ed) Viewing Publishing Company Germany 1995.

Zhao, Jian. "A WWW Service to Embed and Prove Digital Copyright Watermarks", Proc. of the European conf. on Multimedia Applications, Services & Techniques Louvain-La-Nevve Belgium May 1996.

Gruhl, Daniel et al., Echo Hiding. In Proceeding of the Workshop on Information Hiding. No. 1174 in Lecture Notes in Computer Science, Cambridge, England (May/Jun. 1996).

Oomen, A.W.J. et al., A Variable Bit Rate Buried Data Channel for Compact Disc, J.AudioEng. Sc., vol. 43, No. 1/2, pp. 23-28 (1995).

Ten Kate, W. et al., A New Surround-Stereo-Surround Coding Techniques, J. Audio Eng.Soc., vol. 40,No. 5,pp. 376-383 (1992).

Gerzon, Michael et al., A High Rate Buried Data Channel for Audio CD, presentation notes, Audio Engineering Soc. 94th Convention (1993).

Sklar, Bernard, Digital Communications, pp. 601-603 (1988).

Jayant, N.S. et al., Digital Coding of Waveforms, Prentice Hall Inc., Englewood Cliffs, NJ, pp. 486-509 (1984).

Bender, Walter R. et al., Techniques for Data Hiding, SPIE Int. Soc. Opt. Eng., vol. 2420, pp. 164-173, 1995.

Zhao, Jian et al., Embedding Robust Labels into Images for Copyright Protection, (xp 000571976), pp. 242-251, 1995.

Menezes, Alfred J., Handbook of Applied Cryptography, CRC Press, p. 175, 1997.

Schneier, Bruce, Applied Cryptography, 1st Ed., pp. 67-68, 1994.

Ten Kate, W. et al., "Digital Audio Carrying Extra Information", IEEE, CH 2847-2/90/0000-1097, (1990).

Van Schyndel, et al., "A digital Watermark," IEEE Int'l Computer Processing Conference, Austin,TX, Nov. 13-16, 1994, pp. 86-90.

Smith, et al. "Modulation and Information Hiding in Images", Springer Verlag, 1st Int'l Workshop, Cambridge, UK, May 30-Jun. 1, 1996, pp. 207-227.

Kutter, Martin et al., "Digital Signature of Color Images Using Amplitude Modulation", SPIE-E197, vol. 3022, pp. 518-527, 1997.

Puate, Joan et al., "Using Fractal Compression Scheme to Embed a Digital Signature into an Image", SPIE-96 Proceedings, vol. 2915, Mar. 1997, pp. 108-118.

Swanson, Mitchell D.,et al., "Transparent Robust Image Watermarking", Proc. of the 1996 IEEE Int'l Conf. on Image Processing, vol. 111, 1996 , pp. 211-214.

Swanson, Mitchell D., et al. "Robust Data Hiding for Images", 7th IEEE Digital Signal Processing Workshop, Leon, Norway. Sep. 1-4, 1996, pp. 37-40.

Zhao, Jian et al., "Embedding Robust Labels into Images for Copyright Protection", Proceeding of the Know Right '95 Conference, pp. 242-251.

Koch, E., et al., "Towards Robust and Hidden Image Copyright Labeling", 1995 IEEE Workshop on Nonlinear Signal and Image Processing, Jun. 1995 Neos Marmaras pp. 4.

Van Schyandel, et al., "Towards a Robust Digital Watermark", Second Asain Image Processing Conference, Dec. 6-8, 1995, Singapore, vol. 2, pp. 504-508.

Tirkel,A.Z., "A Two-Dimensional Digital Watermark", DICTA '95, Univ. of Queensland, Brisbane, Dec. 5-8, 1995, pp. 7.

Tirkel,A.Z., "Image Watermarking—A Spread Spectrum Application", ISSSTA '96, Sep. 1996, Mainz, German, pp. 6.

O'Ruanaidh, et al. "Watermarking Digital Images for Copyright Protection", IEEE Proceedings, vol. 143, No. 4, Aug. 1996, pp. 250-256.

Cox, et al., Secure Spread Spectrum Watermarking for Multimedia, NEC Research Institude, Techinal Report 95-10, pp. 33.

Kahn, D., "The Code Breakers", The MacMillan Company, 1969, pp. xIII, 81-83, 513, 515, 522-526, 863.

(56) **References Cited**

OTHER PUBLICATIONS

Boney, et al., Digital Watermarks for Audio Signals, EVSIPCO, 96, pp. 473-480 (Mar. 14, 1997).
Dept. of Electrical Engineering, Del Ft University of Technology, Del ft The Netherlands, Cr.C. Langelaar et al.,"Copy Protection for Multimedia Data based on Labeling Techniques", Jul. 1996 9 pp.
F. Hartung, et al., "Digital Watermarking of Raw and Compressed Video", SPIE vol. 2952, pp. 205-213.
Craver, et al., "Can Invisible Watermarks Resolve Rightful Ownerships?", IBM Research Report, RC 20509 (Jul. 25, 1996) 21 pp.
Press, et al., "Numerical Recipes in C", Cambridge Univ. Press, 1988, pp. 398-417.
Pohlmann, Ken C., "Principles of Digital Audio", 3rd Ed., 1995, pp. 32-37, 40-48:138, 147-149, 332, 333, 364, 499-501, 508-509, 564-571.
Pohlmann, Ken C., "Principles of Digital Audio", 2nd Ed., 1991, pp. 1-9, 19-25, 30-33, 41-48, 54-57, 86-107, 375-387.
Schneier, Bruce, Applied Cryptography, John Wiley & Sons, Inc., New York, 1994, pp. 68, 69, 387-392, 1-57, 273-275, 321-324.
Boney, et al., Digital Watermarks for Audio Signals, Proceedings of the International Conf. on Multimedia Computing and Systems, Jun. 17-23, 1996 Hiroshima, Japan, 0-8186-7436-9196, pp. 473-480.
Johnson, et al., "Transform Permuted Watermarking for Copyright Protection of Digital Video", IEEE Globecom 1998, Nov. 8-12, 1998, New York New York vol. 2 1998 pp. 684-689 (ISBN 0-7803-4985-7).
Rivest, et al., "Pay Word and Micromint: Two Simple Micropayment Schemes," MIT Laboratory for Computer Science, Cambridge, MA, May 7, 1996 pp. 1-18.
Bender, et al., "Techniques for Data Hiding", IBM Systems Journal, (1996) vol. 35, Nos. 3 & 4,1996, pp. 313-336.
Moskowitz, "Bandwith as Currency", IEEE Multimedia, Jan.-Mar. 2003, pp. 14-21.
Moskowitz, Multimedia Security Technologies for Digital Rights Management, 2006, Academic Press, "Introduction—Digital Rights Management" pp. 3-22.
Rivest, et al., "PayWord and Micromint: Two Simple Micropayment Schemes," MIT Laboratory for Computer Science, Cambridge, MA, Apr. 27, 2001, pp. 1-18.
Tomsich, et al., "Towards a secure and de-centralized digital watermarking infrastructure for the protection of Intellectual Property", in Electronic Commerce and Web Technologies, Proceedings (ECWEB)(2000).
Moskowitz, "What is Acceptable Quality in the Application of Digital Watermarking: Trade-offs of Security; Robustness and Quality", IEEE Computer Society Proceedings of ITCC 2002 Apr. 10, 2002 pp. 80-84.
Lemma, et al. "Secure Watermark Embedding through Partial Encryption", International Workshop on Digital Watermarking ("IWDW" 2006). Springer Lecture Notes in Computer Science 2006 (to appear) 13.
Kocher, et al., "Self Protecting Digital Content", Technical Report from the CRI Content Security Research Initiative, Cryptography Research, Inc. 2002-2003 14 pages.
Sirbu, M. et al., "Net Bill: An Internet Commerce System Optimized for Network Delivered Services", Digest of Papers of the Computer Society Computer Conference (Spring) Mar. 5, 1995 pp. 20-25 vol. CONF40.
Schunter, M. et al., "A Status Report on the SEMPER framework for Secure Electronic Commerce", Computer Networks and ISDN Systems, Sep. 30, 1998, pp. 1501-1510 vol. 30 No. 16-18 NL North Holland.
Konrad, K. et al., "Trust and Electronic Commerce—more than a technical problem," Proceedings of the 18th IEEE Symposium on Reliable Distributed Systems Oct. 19-22, 1999, pp. 360-365 Lausanne.
Kini, et al., "Trust in Electronic Commerce: Definition and Theoretical Considerations", Proceedings of the 31st Hawaii Int'l Conf on System Sciences (Cat. No. 98TB100216). Jan. 6-9, 1998. pp. 51-61. Los.
Steinauer D. D., et al., "Trust and Traceability in Electronic Commerce", Standard View, Sep. 1997, pp. 118-124, vol. 5 No. 3, ACM, USA.
Hartung, et al. "Multimedia Watermarking Techniques", Proceedings of the IEEE, Special Issue, Identification & Protection of Multimedia Information, pp. 1079-1107 Jul. 1999 vol. 87 No. 7 IEEE.
European Search Report & European Search Opinion in EP07112420.
STAIND (The Singles 1996-2006), Warner Music—Atlantic, Pre-Release CD image, 2006, 1 page.
Radiohead ("Hail to the Thief"), EMI Music Group—Capitol, Pre-Release CD image, 2003, 1 page.
U.S. Appl. No. 60/169,274, filed Dec. 7, 1999, entitled "Systems, Methods and Devices for Trusted Transactions".
U.S. Appl. No. 60/234,199, filed Sep. 20, 2000, "Improved Security Based on Subliminal and Supraliminal Channels for Data Objects".
U.S. Appl. No. 09/671,739, filed Sep. 29, 2000, entitled "Method and Device for Monitoring and Analyzing Signals".
Tirkel, A.Z., "A Two-Dimensional Digital Watermark", Scientific Technology, 686, 14, date unknown.
PCT International Search Report in PCT/US95/08159.
PCT International Search Report in PCT/US96/10257.
Supplementary European Search Report in EP 96919405.
PCT International Search Report in PCT/US97/00651.
PCT International Search Report in PCT/US97/00652.
PCT International Search Report in PCT/US97/11455.
PCT International Search Report in PCT/US99/07262.
PCT International Search Report in PCT/US00/06522.
Supplementary European Search Report in EP00919398.
PCT International Search Report in PCT/US00/18411.
PCT International Search Report in PCT/US00/33126.
PCT International Search Report in PCT/US00/21189.
Delaigle, J.-F., et al. "Digital Watermarking," Proceedings of the SPIE, vol. 2659, Feb. 1, 1996, pp. 99-110.
Schneider, M., et al. "A Robust Content Based Digital Signature for Image Authentication," Proceedings of the International Conference on Image Processing (IC. Lausanne) Sep. 16-19, 1996, pp. 227-230, IEEE ISBN.
Cox, I. J., et al. "Secure Spread Spectrum Watermarking for Multimedia," IEEE Transactions on Image Processing, vol. 6 No. 12, Dec. 1, 1997, pp. 1673-1686.
Wong, Ping Wah. "A Public Key Watermark for Image Verification and Authentication," IEEE International Conference on Image Processing, vol. 1 Oct. 4-7, 1998, pp. 455-459.
Fabien A.P. Petitcolas, Ross J. Anderson and Markkus G. Kuhn, "Attacks on Copyright Marking Systems," LNCS, vol. 1525, Apr. 14-17, 1998, pp. 218-238 ISBN: 3-540-65386-4.
Ross Anderson, "Stretching the Limits of Steganography," LNCS, vol. 1174, May/Jun. 1996, 10 pages, ISBN: 3-540-61996-8.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Image Watermarking", pre-publication, Summer 1997 4 pages.
Joseph J.K. O'Ruanaidh and Thierry Pun, "Rotation, Scale and Translation Invariant Digital Image Watermarking", Submitted to Signal Processing Aug. 21, 1997, 19 pages.
OASIS (Dig Out Your Soul), Big Brother Recordings Ltd, Promotional CD image, 2008, 1 page.
Rivest, R. "Chaffing and Winnowing: Confidentiality without Encryption", MIT Lab for Computer Science, http://people.csail.mit.edu/rivest/Chaffing.txt Apr. 24, 1998, 9 pp.
PortalPlayer, PP5002 digital media management system-on-chip, May 1, 2003, 4 pp.
VeriDisc, "The Search for a Rational Solution to Digital Rights Management (DRM)", http://64.244.235.240/news/whitepaper,/docs/veridisc.sub.—white.sub.—paper.pdf, 2001, 15 pp.
Cayre, et al., "Kerckhoff's-Based Embedding Security Classes for WOA Data Hiding", IEEE Transactions on Information Forensics and Security, vol. 3 No. 1, Mar. 2008, 15 pp.
Wayback Machine, dated Jan. 17, 1999, http://web.archive.org/web/19990117020420/http://www.netzero.com/, accessed on Feb. 19, 2008.

(56) **References Cited**

OTHER PUBLICATIONS

Namgoong, H., "An Integrated Approach to Legacy Data for Multimedia Applications", Proceedings of the 23rd EUROMICRO Conference, vol., Issue 1-4, Sep. 1997, pp. 387-391.
Wayback Machine, dated Aug. 26, 2007, http://web.archive,org/web/20070826151732/http://www.screenplaysmag.com/t-abid/96/articleType/ArticleView/articleId/495/Default.aspx/.
"YouTube Copyright Policy: Video Identification tool—YouTube Help", accessed Jun. 4, 2009, http://www.google.com/support/youtube/bin/answer.py?h1=en&answer=83766, 3 pp.
U.S. Appl. No. 12/665,002, filed Dec. 22, 2009, entitled "Method for Combining Transfer Function with Predetermined Key Creation", published as 20100182570 A1 Jul. 22, 2010, P76.
U.S. Appl. No. 12/592,331, filed Nov. 23, 2009, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 20100077220 A1 Mar. 25, 2010, P77.
U.S. Appl. No. 12/590,553, filed Nov. 10, 2009, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 20100077219 A1 Mar. 25, 2010, P78.
U.S. Appl. No. 12/590,681, filed Nov. 12, 2009, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data", published as 20100064140 A1 Mar. 11, 2010, P79.
U.S. Appl. No. 12/655,036, filed Dec. 22, 2009, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as 20100153734 A1 Jun. 17, 2010, P80.
U.S. Appl. No. 12/655,357, filed Dec. 22, 2009, entitled "Method and Device for Monitoring and Analyzing Signals", published as 20100106736 A1 Apr. 29, 2010, P81.
PCT Application No. PCT/US95/08159, filed Jun. 26, 1995, entitled, "Digital Information Commodities Exchange with Virtual Menuing", published as WO/1997/001892; Publication Date: Jan. 16, 1997, F24.
PCT Application No. PCT/US96/10257, filed Jun. 7, 1996, entitled "Steganographic Method and Device"—corresponding to—EPO Application No. 96919405.9, entitled "Steganographic Method and Device", published as WO/1996/042151; Publication Date: Dec. 27, 1996; F19.
PCT Application No. PCT/US97/00651, filed Jan. 16, 1997, entitled, "Method for Stega-Cipher Protection of Computer Code", published as WO/1997/026732; Publication Date: Jul. 24, 1997.
PCT Application No. PCT/US97/00652, filed Jan. 17, 1997, entitled, "Method for an Encrypted Digital Watermark", published as WO/1997/026733; Publication Date: Jul. 24, 1997.
PCT Application No. PCT/US97/11455, filed Jul. 2, 1997, entitled, "Optimization Methods for the Insertion, Protection and Detection of Digital Watermarks in Digitized Data", published as WO/1998/002864; Publication Date: Jan. 22, 1998.
PCT Application No. PCT/US99/07262, filed Apr. 2, 1999, entitled, "Multiple Transform Utilization and Applications for Secure Digital Watermarking", published as WO/1999/052271; Publication Date: Oct. 14, 1999.
PCT Application No. PCT/US00/06522, filed Mar. 14, 2000, entitled, "Utilizing Data Reduction in Steganographic and Cryptographic Systems", published as WO/2000/057643; Publication Date: Sep. 28, 2000.
PCT Application No. PCT/US00/18411, filed Jul. 5, 2000, entitled, "Copy Protection of Digital Data Combining Steganographic and Cryptographic Techniques".
PCT Application No. PCT/US00/33126, filed Dec. 7, 2000, entitled "Systems, Methods and Devices for Trusted Transactions", published as WO/2001/043026; Publication Date: Jun. 14, 2001.
EPO Divisional Patent Application No. 07112420.0, entitled "Steganographic Method and Device" corresponding to PCT Application No. PCT/US96/10257, published as WO/1996/042151, Dec. 27, 1996, cited herein above as F019.
U.S. Appl. No. 60/222,023, filed Jul. 31, 2007 entitled "Method and apparatus for recognizing sound and signals in high noise and distortion".
U.S. Appl. No. 11/458,639, filed Jul. 19, 2006 entitled "Methods and Systems for Inserting Watermarks in Digital Signals", published as 20060251291 A1 Nov. 9, 2006, P82.
"Techniques for Data Hiding in Audio Files," by Morimoto, 1995.
Howe, Dennis Jul. 13, 1998 http://foldoc..org//steganography.
CSG, Computer Support Group and CSGNetwork.com 1973 http://www.csgnetwork.com/glossarys.html.
QuinStreet Inc. 2010 What is steganography?—A word definition from the Webopedia Computer Dictionary http://www.webopedia.com/terms/steganography.html.
Graham, Robert Aug. 21, 2000 "Hacking Lexicon" http://robertgraham.com/pubs/hacking-dict.html.
Farkex, Inc 2010 "Steganography definition of steganography in the Free Online Encyclopedia" http://encyclopedia2.Thefreedictionary.com/steganography.
Horowitz, et al., The Art of Eletronics. 2nd Ed., 1989, pp. 7.
Jimmy eat world ("futures"), Interscope Records, Pre-Release CD image, 2004, 1 page.
Aerosmith ("Just Push Play"), Pre-Release CD image, 2001, 1 page.
Phil Collins(Testify) Atlantic, Pre-Release CD image, 2002, 1 page.
U. are U. Reviewer's Guide (U are U Software, 1998).
U. are U. wins top honors!—Marketing Flyer (U. are U. Software, 1998).
Digital Persona, Inc., *U. are U. Fingerprint Recognition System: User Guide* (Version 1.0, 1998).
Digital Persona White Paper pp. 8-9 published Apr. 15, 1998.
Digital Persona, Inc., "Digital Persona Releases U. are. U Pro Fingerprint Security Systems for Windows NT, 2000, '98, '95", (Feb. 2000).
SonicWall, Inc. 2011 "The Network Security SonicOS Platform-Deep Packet Inspection" http://www.sonicwall.com/us/en/products/Deep_Packet_Inspection.html.
Rick Merritt, PARC hosts summit on content-centric nets, EETimes, Aug. 12, 2011, http://www.eetimes.com/electronics-news/4218741/PARC-hosts-summit-on-content-centric-nets.
Afanasyev, et. al., Communications of the ACM: Privacy Preserving Network Forensics 2011.

* cited by examiner

METHOD AND DEVICE FOR MONITORING AND ANALYZING SIGNALS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application No. 13/487,119, filed Jun. 1, 2012, which is a continuation of application No. 13/035,964, filed Feb. 26, 2011, which is a continuation of application Ser. No. 12/655,357, filed Dec. 22, 2009, now U.S. Pat. No. 7,949,494, which is a continuation of application Ser. No. 12/005,229, filed Dec. 26, 2007, now U.S. Pat. No. 7,660,700, which is a continuation of application Ser. No. 09/657,181, filed Sep. 7, 2000, now U.S. Pat. No. 7,346,472. The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties, as if fully stated herein.

This application is related to U.S. patent application Ser. No. 08/999,766, filed Jul. 23, 1997, entitled "Steganographic Method and Device" (issued as U.S. Pat. No. 7,568,100); U.S. patent application Ser. No. 08/772,222, filed Dec. 20, 1996, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,078,664); U.S. patent application Ser. No. 09/456,319, filed Dec. 8, 1999, entitled "Z-Transform Implementation of Digital Watermarks" (issued as U.S. Pat. No. 6,853,726); U.S. patent application. Ser. No. 08/674,726, filed Jul. 2, 1996, entitled "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (issued as U.S. Pat. No. 7,362,775); U.S. patent application Ser. No. 09/545,589, filed Apr. 7, 2000, entitled "Method and System for Digital Watermarking" (issued as U.S. Pat. No. 7,007,166); U.S. patent application Ser. No. 09/046,627, filed Mar. 24, 1998, entitled "Method for Combining Transfer Function with Predetermined Key Creation" (issued as U.S. Pat. No. 6,598,162); U.S. patent application Ser. No. 09/053,628, filed Apr. 2, 1998, entitled "Multiple Transform Utilization and Application for Secure Digital Watermarking" (issued as U.S. Pat. No. 6,205,249); pending U.S. patent application Ser. No. 09/281,279, filed Mar. 30, 1999, entitled "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digital Data (issued as U.S. Pat. No. 6,522,767)"; U.S. patent application Ser. No. 09,594,719, filed Jun. 16, 2000, entitled "Utilizing Data Reduction in Steganographic and Cryptographic Systems" (which is a continuation-in-part of PCT application No. PCT/US00/06522, filed Mar. 14, 2000, which PCT application claimed priority to U.S. Provisional Application No. 60/125,990, filed Mar. 24, 1999) (issued as U.S. Pat. No. 7,123,718); pending U.S. application Ser. No. 60/169,274, filed Dec. 7, 1999, entitled "Systems, Methods And Devices For Trusted Transactions" (issued as U.S. Pat. No. 7,159,116); and PCT Application No. PCT/US00/21189, filed Aug. 4, 2000 (which claims priority to U.S. patent application Ser. No. 60/147,134, filed Aug. 4, 1999, and to U.S. patent application Ser. No. 60/213,489, filed Jun. 23, 2000, both of which are entitled, "A Secure Personal Content Server") (issued as U.S. Pat. No. 7,475,246). The previously identified patents and/or patent applications are hereby incorporated by reference, in their entireties, as if fully stated herein.

In addition, this application hereby incorporates by reference, as if fully stated herein, the total disclosures of U.S. Pat. No. 5,613,004 "Steganographic Method and Device"; U.S. Pat. No. 5,745,569 "Method for Stega-Cipher Protection of Computer Code"; and U.S. Pat. No. 5,889,868 "Optimization Methods for the Insertion, Protection, and Detection of Digital Watermarks in Digitized Data."

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to the monitoring and analysis of digital information. A method and device are described which relate to signal recognition to enhance identification and monitoring activities.

2. Description of the Related Art

Many methods and protocols are known for transmitting data in digital form for multimedia applications (including computer applications delivered over public networks such as the internet or World Wide Web ("WWW"). These methods may include protocols for the compression of data, such that it may more readily and quickly be delivered over limited bandwidth data lines. Among standard protocols for data compression of digital files may be mentioned the MPEG compression standards for audio and video digital compression, promulgated by the Moving Picture Experts Group. Numerous standard reference works and patents discuss such compression and transmission standards for digitized information.

Digital watermarks help to authenticate the content of digitized multimedia information, and can also discourage piracy. Because piracy is clearly a disincentive to the digital distribution of copyrighted content, establishment of responsibility for copies and derivative copies of such works is invaluable. In considering the various forms of multimedia content, whether "master," stereo, NTSC video, audio tape or compact disc, tolerance of quality will vary with individuals and affect the underlying commercial and aesthetic value of the content. It is desirable to tie copyrights, ownership rights, purchaser information or some combination of these and related data into the content in such a manner that the content must undergo damage, and therefore reduction of its value, with subsequent, unauthorized distribution, commercial or otherwise. Digital watermarks address many of these concerns. A general discussion of digital watermarking as it has been applied in the art may be found in U.S. Pat. No. 5,687,236 (whose specification is incorporated in whole herein by reference).

Further applications of basic digital watermarking functionality have also been developed. Examples of such applications are shown in U.S. Pat. No. 5,889,868 (whose specification is incorporated in whole herein by reference). Such applications have been drawn, for instance, to implementations of digital watermarks that were deemed most suited to particular transmissions, or particular distribution and storage mediums, given the nature of digitally sampled audio, video, and other multimedia works. There have also been developed techniques for adapting watermark application parameters to the individual characteristics of a given digital sample stream, and for implementation of digital watermarks that are feature-based—i.e., a system in which watermark information is not carried in individual samples, but is carried in the relationships between multiple samples, such as in a waveform shape. For instance, natural extensions may be added to digital watermarks that may also separate frequencies (color or audio), channels in 3D while utilizing discreteness in feature-based encoding only known to those with pseudo-random keys (i.e., cryptographic keys) or possibly tools to access such information, which may one day exist on a quantum level.

A matter of general weakness in digital watermark technology relates directly to the manner of implementation of the

watermark. Many approaches to digital watermarking leave detection and decode control with the implementing party of the digital watermark, not the creator of the work to be protected. This weakness removes proper economic incentives for improvement of the technology. One specific form of exploitation mostly regards efforts to obscure subsequent watermark detection. Others regard successful over encoding using the same watermarking process at a subsequent time. Yet another way to perform secure digital watermark implementation is through "key-based" approaches.

SUMMARY OF THE INVENTION

A method for monitoring and analyzing at least one signal is disclosed, which method comprises the steps of: receiving at least one reference signal to be monitored; creating an abstract of the at least one reference signal; storing the abstract of the at least one reference signal in a reference database; receiving at least one query signal to be analyzed; creating an abstract of the at least one query signal; and comparing the abstract of the at least one query signal to the abstract of the at least one reference signal to determine if the abstract of the at least one query signal matches the abstract of the at least one reference signal.

A method for monitoring a plurality of reference signals is also disclosed, which method comprises the steps of: creating an abstract for each one of a plurality of reference signals; storing each of the abstracts in a reference database; receiving at least one query signal to be analyzed; creating an abstract of each at least one query signal; locating an abstract in the reference database that matches the abstract of each at least one query signal; and recording the identify of the reference signal whose abstract matched the abstract of each at least one query signal.

A computerized system for monitoring and analyzing at least one signal is also disclosed, which system comprises: a processor for creating an abstract of a signal using selectable criteria; a first input for receiving at least one reference signal to be monitored, the first input being coupled to the processor such that the processor may generate an abstract for each reference signal input to the processor; a reference database, coupled to the processor, for storing abstracts of each at least one reference signal; a second input for receiving at least one query signal to be analyzed, the second input being coupled to the processor such that the processor may generate an abstract for each query signal; and a comparing device, coupled to the reference database and to the second input, for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

Further, an electronic system for monitoring and analyzing at least one signal is disclosed, which system comprises: a first input for receiving at least one reference signal to be monitored, a first processor for creating an abstract of each reference signal input to the first processor through the first input; a second input for receiving at least one query signal to be analyzed, a second processor for creating an abstract of each query signal; a reference database for storing abstracts of each at least one reference signal; and a comparing device for comparing an abstract of the at least one query signal to the abstracts stored in the reference database to determine if the abstract of the at least one query signal matches any of the stored abstracts.

DETAILED DESCRIPTION OF THE INVENTION

While there are many approaches to data reduction that can be utilized, a primary concern is the ability to reduce the digital signal in such a manner as to retain a "perceptual relationship" between the original signal and its data reduced version. This relationship may either be mathematically discernible or a result of market-dictated needs. The purpose is to afford a more consistent means for classifying signals than proprietary, related text-based approaches. A simple analogy is the way in which a forensic investigator uses a sketch artist to assist in determining the identity of a human.

In one embodiment of the invention, the abstract of a signal may be generated by the following steps: 1) analyze the characteristics of each signal in a group of audible/perceptible variations for the same signal (e.g., analyze each of five versions of the same song—which versions may have the same lyrics and music but which are sung by different artists); and 2) select those characteristics which achieve or remain relatively constant (or in other words, which have minimum variation) for each of the signals in the group. Optionally, the null case may be defined using those characteristics which are common to each member of the group of versions.

Lossless and lossy compression schemes are appropriate candidates for data reduction technologies, as are those subset of approaches that are based on perceptual models, such as AAC, MP3, TwinVQ, JPEG, GIF, MPEG, etc. Where spectral transforms fail to assist in greater data reduction of the signal, other signal characteristics can be identified as candidates for further data reduction. Linear predictive coding (LPC), z-transform analysis, root mean square (rms), signal to peak, may be appropriate tools to measure signal characteristics, but other approaches or combinations of signal characteristic analysis are contemplated. While such signal characteristics may assist in determining particular applications of the present invention, a generalized approach to signal recognition is necessary to optimize the deployment and use of the present invention.

Increasingly, valuable information is being created and stored in digital form. For example, music, photographs and motion pictures can all be stored and transmitted as a series of binary digits—1's and 0's. Digital techniques permit the original information to be duplicated repeatedly with perfect or near perfect accuracy, and each copy is perceived by viewers or listeners as indistinguishable from the original signal. Unfortunately, digital techniques also permit the information to be easily copied without the owner's permission. While digital representations of analog waveforms may be analyzed by perceptually-based or perceptually-limited analysis it is usually costly and time-consuming to model the processes of the highly effective ability of humans to identify and recognize a signal. In those applications where analog signals require analysis, the cost of digitizing the analog signal is minimal when compared to the benefits of increased accuracy and speed of signal analysis and monitoring when the processes contemplated by this invention are utilized.

The present invention relates to identification of digitally-sampled information, such as images, audio and video. Traditional methods of identification and monitoring of those signals do not rely on "perceptual quality," but rather upon a separate and additional signal. Within this application, such signals will be called "additive signals" as they provide information about the original images, audio or video, but such information is in addition to the original signal. One traditional, text-based additive signal is title and author information. The title and author, for example, is information about a book, but it is in addition to the text of the book. If a book is being duplicated digitally, the title and author could provide one means of monitoring the number of times the text is being duplicated, for example, through an Internet download. The present invention, however, is directed to the identification of

a digital signal—whether text, audio, or video—using only the digital signal itself and then monitoring the number of times the signal is duplicated. Reliance on an additive signal has many shortcomings. For example, first, someone must incorporate the additive signal within the digital data being transmitted, for example, by concatenation or through an embedding process. Such an additive signal, however, can be easily identified and removed by one who wants to utilize the original signal without paying for its usage. If the original signal itself is used to identify the content, an unauthorized user could not avoid payment of a royalty simply by removing the additive signal—because there is no additive signal to remove. Hence, the present invention avoids a major disadvantage of the prior art.

One such additive signal that may be utilized is a digital watermark—which ideally cannot be removed without perceptually altering the original signal. A watermark may also be used as a monitoring signal (for example, by encoding an identifier that uniquely identifies the original digital signal into which the identifier is being embedded). A digital watermark used for monitoring is also an additive signal, and such a signal may make it difficult for the user who wants to duplicate a signal without paying a royalty—mainly by degrading the perceptual quality of the original signal if the watermark (and hence the additive monitoring signal) is removed. This is, however, is a different solution to the problem.

The present invention eliminates the need of any additive monitoring signal because the present invention utilizes the underlying content signal as the identifier itself. Nevertheless, the watermark may increase the value of monitoring techniques by increasing the integrity of the embedded data and by indicating tampering of either the original content signal or the monitoring signal. Moreover, the design of a watermarking embedding algorithm is closely related to the perceptibility of noise in any given signal and can represent an ideal subset of the original signal: the watermark bits are an inverse of the signal to the extent that lossy compression schemes, which can be used, for instance, to optimize a watermarking embedding scheme, can yield information about the extent to which a data signal can be compressed while holding steadfast to the design requirement that the compressed signal maintain its perceptual relationship with the original, uncompressed signal. By describing those bits that are candidates for imperceptible embedding of watermark bits, further data reduction may be applied on the candidate watermarks as an example of retaining a logical and perceptible relationship with the original uncompressed signal.

Of course, the present invention may be used in conjunction with watermarking technology (including the use of keys to accomplish secure digital watermarking), but watermarking is not necessary to practice the present invention. Keys for watermarking may have many forms, including: descriptions of the original carrier file formatting, mapping of embedded data (actually imperceptible changes made to the carrier signal and referenced to the predetermined key or key pairs), assisting in establishing the watermark message data integrity (by incorporation of special one way functions in the watermark message data or key), etc. Discussions of these systems in the patents and pending patent applications are incorporated by reference above. The "recognition" of a particular signal or an instance of its transmission, and its monitoring are operations that may be optimized through the use of digital watermark analysis.

A practical difference between the two approaches of using a separate, additive monitoring signal and using the original signal itself as the monitoring signal is control. If a separate signal is used for monitoring, then the originator of the text, audio or video signal being transmitted and the entity doing the monitoring have to agree as to the nature of the separate signal to be used for monitoring—otherwise, the entity doing the monitoring would not know where to look, for what to look, or how to interpret the monitoring signal once it was identified and detected. On the other hand, if the original signal is used itself as a monitoring signal, then no such agreement is necessary. Moreover, a more logical and self-sufficient relationship between the original and its data-reduced abstract enhances the transparency of any resulting monitoring efforts. The entity doing the monitoring is not looking for a separate, additive monitoring system, and further, need not have to interpret the content of the monitoring signal.

Monitoring implementations can be handled by robust watermark techniques (those techniques that are able to survive many signal manipulations but are not inherently "secure" for verification of a carrier signal absent a logically-related watermarking key) and forensic watermark techniques (which enable embedding of watermarks that are not able to survive perceptible alteration of the carrier signal and thus enable detection of tampering with the originally watermarked carrier signal). The techniques have obvious trade-offs between speed, performance and security of the embedded watermark data.

In other disclosures, we suggest improvements and implementations that relate to digital watermarks in particular and embedded signaling in general. A digital watermark may be used to "tag" content in a manner that is not humanly-perceptible, in order to ensure that the human perception of the signal quality is maintained. Watermarking, however, must inherently alter at least one data bit of the original signal to represent a minimal change from the original signal's "unwatermarked state." The changes may affect only a bit, at the very least, or be dependent on information hiding relating to signal characteristics, such as phase information, differences between digitized samples, root mean square (RMS) calculations, z-transform analysis, or similar signal characteristic category.

There are weaknesses in using digital watermark technology for monitoring purposes. One weakness relates directly to the way in which watermarks are implemented. Often, the persons responsible for encoding and decoding the digital watermark are not the creator of the valuable work to be protected. As such, the creator has no input on the placement of the monitoring signal within the valuable work being protected. Hence, if a user wishing to avoid payment of the royalty can find a way to decode or remove the watermark, or at least the monitoring signal embedded in the watermark, then the unauthorized user may successfully duplicate the signal with impunity. This could occur, for example, if either of the persons responsible for encoding or decoding were to have their security compromised such that the encoding or decoding algorithms were discovered by the unauthorized user.

With the present invention, no such disadvantages exist because the creator need not rely on anyone to insert a monitoring signal—as no such signal is necessary. Instead, the creator's work itself is used as the monitoring signal. Accordingly, the value in the signal will have a strong relationship with its recognizability.

By way of improving methods for efficient monitoring as well as effective confirmation of the identity of a digitally-sampled signal, the present invention describes useful methods for using digital signal processing for benchmarking a novel basis for differencing signals with binary data compari-

sons. These techniques may be complemented with perceptual techniques, but are intended to leverage the generally decreasing cost of bandwidth and signal processing power in an age of increasing availability and exchange of digitized binary data.

So long as there exist computationally inexpensive ways of identifying an entire signal with some fractional representation or relationship with the original signal, or its perceptually observable representation, we envision methods for faster and more accurate auditing of signals as they are played, distributed or otherwise shared amongst providers (transmitters) and consumers (receivers). The ability to massively compress a signal to its Essence—which is not strictly equivalent to "lossy" or "lossless" compression schemes or perceptual coding techniques, but designed to preserve some underlying "aesthetic quality" of the signal—represents a useful means for signal analysis in a wide variety of applications. The signal analysis, however, must maintain the ability to distinguish the perceptual quality of the signals being compared. For example, a method which analyzed a portion of a song by compressing it to a single line of lyrics fails to maintain the ability to distinguish the perceptual quality of the songs being compared. Specifically, for example, if the song "New York State of Mind" were compressed to the lyrics "I'm in a New York State of Mind," such a compression fails to maintain the ability to distinguish between the various recorded versions of the song, say, for example between Billy Joel's recording and Barbara Streisand's recording. Such a method is, therefore, incapable of providing accurate monitoring of the artist's recordings because it could not determine which of the two artists is deserving of a royalty—unless of course, there is a separate monitoring signal to provide the name of the artist or other information sufficient to distinguish the two versions. The present invention, however, aims to maintain some level of perceptual quality of the signals being compared and would deem such a compression to be excessive.

This analogy can be made clearer if it is understood that there are a large number of approaches to compressing a signal to, say, $1/10{,}000^{th}$ of its original size, not for maintaining its signal quality to ensure computational ease for commercial quality distribution, but to assist in identification, analysis or monitoring of the signal. Most compression is either lossy or lossless and is designed with psychoacoustic or psychovisual parameters. That is to say, the signal is compressed to retain what is "humanly-perceptible." As long as the compression successfully mimics human perception, data space may be saved when the compressed file is compared to the uncompressed or original file. While psychoacoustic and psychovisual compression has some relevance to the present invention, additional data reduction or massive compression is anticipated by the present invention. It is anticipated that the original signal may be compressed to create a realistic or self-similar representation of the original signal, so that the compressed signal can be referenced at a subsequent time as unique binary data that has computational relevance to the original signal. Depending on the application, general data reduction of the original signal can be as simple as massive compression or may relate to the watermark encoding envelope parameter (those bits which a watermarking encoding algorithm deem as candidate bits for mapping independent data or those bits deemed imperceptible to human senses but detectable to a watermark detection algorithm). In this manner, certain media which are commonly known by signal characteristics, a painting, a song, a TV commercial, a dialect, etc., may be analyzed more accurately, and perhaps, more efficiently than a text-based descriptor of the signal. So long as the sender and receiver agree that the data representation is

accurate, even insofar as the data-reduction technique has logical relationships with the perceptibility of the original signal, as they must with commonly agreed to text descriptors, no independent cataloging is necessary.

The present invention generally contemplates a signal recognition system that has at least five elements. The actual number of elements may vary depending on the number of domains in which a signal resides (for example, audio is at least one domain while visual carriers are at least two dimensional). The present invention contemplates that the number of elements will be sufficient to effectively and efficiently meet the demands of various classes of signal recognition. The design of the signal recognition that may be used with data reduction is better understood in the context of the general requirements of a pattern or signal recognition system.

The first element is the reference database, which contains information about a plurality of potential signals that will be monitored. In one form, the reference database would contain digital copies of original works of art as they are recorded by the various artists, for example, contain digital copies of all songs that will be played by a particular radio station. In another form, the reference database would contain not perfect digital copies of original works of art, but digital copies of abstracted works of art, for example, contain digital copies of all songs that have been preprocessed such that the copies represent the perceptual characteristics of the original songs. In another form, the reference database would contain digital copies of processed data files, which files represent works of art that have been preprocessed in such a fashion as to identify those perceptual differences that can differentiate one version of a work of art from another version of the same work of art, such as two or more versions of the same song, but by different artists. These examples have obvious application to visually communicated works such as images, trademarks or photographs, and video as well.

The second element is the object locator, which is able to segment a portion of a signal being monitored for analysis (i.e., the "monitored signal"). The segmented portion is also referred to as an "object." As such, the signal being monitored may be thought of comprising a set of objects. A song recording, for example, can be thought of as having a multitude of objects. The objects need not be of uniform length, size, or content, but merely be a sample of the signal being monitored. Visually communicated informational signals have related objects; color and size are examples.

The third element is the feature selector, which is able to analyze a selected object and identify perceptual features of the object that can be used to uniquely describe the selected object. Ideally, the feature selector can identify all, or nearly all, of the perceptual qualities of the object that differentiate it from a similarly selected object of other signals. Simply, a feature selector has a direct relationship with the perceptibility of features commonly observed. Counterfeiting is an activity which specifically seeks out features to misrepresent the authenticity of any given object. Highly granular, and arguably successful, counterfeiting is typically sought for objects that are easily recognizable and valuable, for example, currency, stamps, and trademarked or copyrighted works and objects that have value to a body politic.

The fourth element is the comparing device which is able to compare the selected object using the features selected by the feature selector to the plurality of signals in the reference database to identify which of the signals matches the monitored signal. Depending upon how the information of the plurality of signals is stored in the reference database and depending upon the available computational capacity (e.g., speed and efficiency), the exact nature of the comparison will

vary. For example, the comparing device may compare the selected object directly to the signal information stored in the database. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector and then compare the selected object to the processed signal information. Alternatively, the comparing device may need to process the selected object using input from the feature selector and then compare the processed selected object to the signal information. Alternatively, the comparing device may need to process the signal information stored in the database using input from the feature selector, process the selected object using input from the feature selector, and then compare the processed selected object to the processed signal information.

The fifth element is the recorder which records information about the number of times a given signal is analyzed and detected. The recorder may comprise a database which keeps track of the number of times a song, image, or a movie has been played, or may generate a serial output which can be subsequently processed to determine the total number of times various signals have been detected.

Other elements may be added to the system or incorporated into the five elements identified above. For example, an error handler may be incorporated into the comparing device. If the comparing device identifies multiple signals which appear to contain the object being sought for analysis or monitoring, the error handler may offer further processing in order to identify additional qualities or features in the selected object such that only one of the set of captured signals is found to contain the further analyzed selected object that actually conforms with the object thought to have been transmitted or distributed.

Moreover, one or more of the five identified elements may be implemented with software that runs on the same processor, or which uses multiple processors. In addition, the elements may incorporate dynamic approaches that utilize stochastic, heuristic, or experience-based adjustments to refine the signal analysis being conducted within the system, including, for example, the signal analyses being performed within the feature selector and the comparing device. This additional analyses may be viewed as filters that are designed to meet the expectations of accuracy or speed for any intended application.

Since maintenance of original signal quality is not required by the present invention, increased efficiencies in processing and identification of signals can be achieved. The present invention concerns itself with perceptible relationships only to the extent that efficiencies can be achieved both in accuracy and speed with enabling logical relationships between an original signal and its abstract.

The challenge is to maximize the ability to sufficiently compress a signal to both retain its relationship with the original signal while reducing the data overhead to enable more efficient analysis, archiving and monitoring of these signals. In some cases, data reduction alone will not suffice: the sender and receiver must agree to the accuracy of the recognition. In other cases, agreement will actually depend on a third party who authored or created the signal in question. A digitized signal may have parameters to assist in establishing more accurate identification, for example, a "signal abstract" which naturally, or by agreement with the creator, the copyright owner or other interested parties, can be used to describe the original signal. By utilizing less than the original signal, a computationally inexpensive means of identification can be used. As long as a realistic set of conditions can be arrived at governing the relationship between a signal and its data reduced abstract, increases in effective monitoring and transparency of information data flow across communications channels is likely to result. This feature is significant in that it represents an improvement over how a digitally-sampled signal can be cataloged and identified, though the use of a means that is specifically selected based upon the strengths of a general computing device and the economic needs of a particular market for the digitized information data being monitored. The additional benefit is a more open means to uniformly catalog, analyze, and monitor signals. As well, such benefits can exist for third parties, who have a significant interest in the signal but are not the sender or receiver of said information.

As a general improvement over the art, the present invention incorporates what could best be described as "computer-acoustic" and "computer-visual" modeling, where the signal abstracts are created using data reduction techniques to determine the smallest amount of data, at least a single bit, which can represent and differentiate two digitized signal representations for a given predefined signal set. Each of such representations must have at least a one bit difference with all other members of the database to differentiate each such representation from the others in the database. The predefined signal set is the object being analyzed. The signal identifier/detector should receive its parameters from a database engine. The engine will identify those characteristics (for example, the differences) that can be used to distinguish one digital signal from all other digital signals that are stored in its collection. For those digital signals or objects which are seemingly identical, except[ing] that the signal may have different performance or utilization in the newly created object, benefits over additive or text-based identifiers are achieved. Additionally, decisions regarding the success or failure of an accurate detection of any given object may be flexibly implemented or changed to reflect market-based demands of the engine. Appropriate examples are songs or works or art which have been sampled or reproduced by others who are not the original creator.

In some cases, the engine will also consider the NULL case for a generalized item not in its database, or perhaps in situations where data objects may have collisions. For some applications, the NULL case is not necessary, thus making the whole system faster. For instance, databases which have fewer repetitions of objects or those systems which are intended to recognize signals with time constraints or capture all data objects. Greater efficiency in processing a relational database can be obtained because the rules for comparison are selected for the maximum efficiency of the processing hardware and/or software, whether or not the processing is based on psychoacoustic or psychovisual models. The benefits of massive data reduction, flexibility in constructing appropriate signal recognition protocols and incorporation of cryptographic techniques to further add accuracy and confidence in the system are clearly improvements over the art. For example, where the data reduced abstract needs to have further uniqueness, a hash or signature may be required. And for objects which have further uniqueness requirements, two identical instances of the object could be made unique with cryptographic techniques.

Accuracy in processing and identification may be increased by using one or more of the following fidelity evaluation functions:

1) RMS (root mean square). For example, a RMS function may be used to assist in determining the distance between data based on mathematically determinable Euclidean distance between the beginning and end data points (bits) of a particular signal carrier.

2) Frequency weighted RMS. For example, different weights may be applied to different frequency components of

the carrier signal before using RMS. This selective weighting can assist in further distinguishing the distance between beginning and end points of the signal carrier (at a given point in time, described as bandwidth, or the number of total bits that can be transmitted per second) and may be considered to be the mathematical equivalent of passing a carrier signal difference through a data filter and figuring the average power in the output carrier.

3) Absolute error criteria, including particularly the NULL set (described above) The NULL may be utilized in two significant cases: First, in instances where the recognized, signal appears to be an identified object which is inaccurately attributed or identified to an object not handled by the database of objects; and second, where a collision of data occurs. For instance, if an artist releases a second performance of a previously recorded song, and the two performances are so similar that their differences are almost imperceptible, then the previously selected criteria may not be able to differentiate the two recordings. Hence, the database must be "recalibrated" to be able to differentiate these two versions. Similarly, if the system identifies not one, but two or more, matches for a particular search, then the database may need "recalibration" to further differentiate the two objects stored in the database.

4) Cognitive Identification. For example, the present invention may use an experience-based analysis within a recognition engine. Once such analysis may involve mathematically determining a spectral transform or its equivalent of the carrier signal. A spectral transform enables signal processing and should maintain, for certain applications, some cognitive or perceptual relationship with the original analog waveform. As a novel feature to the present invention, additional classes may be subject to humanly-perceptible observation. For instance, an experience-based criteria which relates particularly to the envisioned or perceived accuracy of the data information object as it is used or applied in a particular market, product, or implementation. This may include a short **3** second segment of a commercially available and recognizable song which is used for commercials to enable recognition of the good or service being marketed. The complete song is marketed as a separately valued object from the use of a discrete segment of the song (that may be used for promotion or marketing—for the complete song or for an entirely different good or service). To the extent that an owner of the song in question is able to further enable value through the licensing or agreement for use of a segment of the original signal, cognitive identification is a form of filtering to enable differentiations between different and intended uses of the same or subset of the same signal (object). The implementation relating specifically, as disclosed herein, to the predetermined identification or recognition means and/or any specified relationship with subsequent use of the identification means can be used to create a history as to how often a particular signal is misidentified, which history can then be used to optimize identification of that signal in the future. The difference between use of an excerpt of the song to promote a separate and distinct good or service and use of the excerpt to promote recognition of the song itself (for example, by the artist to sell copies of the song) relates informationally to a decision based on recognized and approved use of the song. Both the song and applications of the song in its entirety or as a subset are typically based on agreement by the creator and the sender who seeks to utilize the work. Trust in the means for identification, which can be weighted in the present invention (for example, by adjusting bit-addressable information), is an important factor in adjusting the monitoring or recognition features of the object or carrier signal, and by using any

misidentification information, (including any experience-based or heuristic information), additional features of the monitored signal can be used to improve the performance of the monitoring system envisioned herein. The issue of central concern with cognitive identification is a greater understanding of the parameters by which any given object is to be analyzed. To the extent that a creator chooses varying and separate application of his object, those applications having a cognitive difference in a signal recognition sense (e.g., the whole or an excerpt), the system contemplated herein includes rules for governing the application of bit-addressable information to increase the accuracy of the database.

5) Finally, the predetermined parameters that are associated with a discrete case for any given object will have a significant impact upon the ability to accurately process and identify the signals. For example, if a song is transmitted over a FM carrier, then one skilled in the art will appreciate that the FM signal has a predetermined bandwidth which is different from the bandwidth of the original recording, and different even from song when played on an AM carrier, and different yet from a song played using an 8-bit Internet broadcast. Recognition of these differences, however, will permit the selection of an identification means which can be optimized for monitoring a FM broadcasted signal. In other words, the discreteness intended by the sender is limited and directed by the fidelity of the transmission means. Objects may be cataloged and assessing with the understanding that all monitoring will occur using a specific transmission fidelity. For example, a database may be optimized with the understanding that only AM broadcast signals will be monitored. For maximum efficiency, different data bases may be created for different transmission channels, e.g., AM broadcasts, FM broadcasts, Internet broadcasts, etc.

For more information on increasing efficiencies for information systems, see The Mathematical Theory of Communication (1948), by Shannon.

Because bandwidth (which in the digital domain is equated to the total number of bits that can be transmitted in a fixed period of time) is a limited resource which places limitations upon transmission capacity and information coding schemes, the importance of monitoring for information objects transmitted over any given channel must take into consideration the nature and utilization of a given channel. The supply and demand of bandwidth will have a dramatic impact on the transmission, and ultimately, upon the decision to monitor and recognize signals. A discussion of this is found in a co-pending application by the inventor under U.S. patent application Ser. No. 08/674,726 (which issued Apr. 22, 2008 as U.S. Pat. No. 7,362,775) "Exchange Mechanisms for Digital Information Packages with Bandwidth Securitization, Multichannel Digital Watermarks, and Key Management" (which application is incorporated herein by reference as if fully setforth herein).

If a filter is to be used in connection with the recognition or monitoring engine, it may be desirable for the filter to anticipate and take into consideration the following factors, which affect the economics of the transmission as they relate to triggers for payment and/or relate to events requiring audits of the objects which are being transmitted: 1) time of transmission (i.e., the point in time when the transmission occurred), including whether the transmission is of a live performance); 2) location of transmission (e.g., what channel was used for transmission, which usually determines the associated cost for usage of the transmission channel); 3) the point of origination of the transmission (which may be the same for a signal carrier over many distinct channels); and 4) pre-existence of the information carrier signal (pre-recorded or newly created

information carrier signal, which may require differentiation in certain markets or instances).

In the case of predetermined carrier signals (those which have been recorded and stored for subsequent use), "positional information carrier signals" are contemplated by this invention, namely, perceptual differences between the seemingly "same" information carrier that can be recognized as consumers of information seek different versions or quality levels of the same carrier signal. Perceptual differences exist between a song and its reproduction from a CD, an AM radio, and an Internet broadcast. To the extent that the creator or consumer of the signal can define a difference in any of the four criteria above, means can be derived (and programmed for selectability) to recognize and distinguish these differences. It is, however, quite possible that the ability to monitor carrier signal transmission with these factors will increase the variety and richness of available carrier signals to existing communications channels. The differentiation between an absolute case for transmission of an object, which is a time dependent event, for instance a live or real time broadcast, versus the relative case, which is prerecorded or stored for transmission at a later point in time, creates recognizable differences for signal monitoring.

The monitoring and analysis contemplated by this invention may have a variety of purposes, including, for example, the following: to determine the number of times a song is broadcast on a particular radio broadcast or Internet site; to control security though a voice-activated security system; and to identify associations between a beginner's drawing and those of great artists (for example to draw comparisons between technique, compositions, or color schemes). None of these examples could be achieved with any significant degree of accuracy using a text-based analysis. Additionally, strictly text-based systems fail to fully capture the inherent value of the data recognition or monitoring information itself.

Sample Embodiments

Sample Embodiment 1

A database of audio signals (e.g., songs) is stored or maintained by a radio station or Internet streaming company, who may select a subset of the songs are stored so that the subset may be later broadcast to listeners. The subset, for example, may comprise a sufficient number of songs to fill 24 hours of music programming (between 300 or 500 songs). Traditionally, monitoring is accomplished by embedding some identifier into the signal, or affixing the identifier to the signal, for later analysis and determination of royalty payments. Most of the traditional analysis is performed by actual persons who use play lists and other statistical approximations of audio play, including for example, data obtained through the manual (i.e., by persons) monitoring of a statistically significant sample of stations and transmission times so that an extrapolation may be made to a larger number of comparable markets.

The present invention creates a second database from the first database, wherein each of the stored audio signals in the first database is data reduced in a manner that is not likely to reflect the human perceptual quality of the signal, meaning that a significantly data-reduced signal is not likely to be played back and recognized as the original signal. As a result of the data reduction, the size of the second database (as measured in digital terms) is much smaller than the size of the first database, and is determined by the rate of compression. If, for example, if 24 hours worth of audio signals are compressed at a 10,000:1 compression rate, the reduced data could occupy a little more than 1 megabyte of data. With such a large compression rate, the data to be compared and/or analyzed may become computationally small such that computational speed and efficiency are significantly improved.

With greater compression rates, it is anticipated that similarity may exist between the data compressed abstractions of different analog signals (e.g., recordings by two different artists of the same song). The present invention contemplates the use of bit-addressable differences to distinguish between such cases. In applications where the data to be analyzed has higher value in some predetermined sense, cryptographic protocols, such as a hash or digital signature, can be used to distinguish such close cases.

In a preferred embodiment, the present invention may utilize a centralized database where copies of new recordings may be deposited to ensure that copyright owners, who authorize transmission or use of their recordings by others, can independently verify that the object is correctly monitored. The rules for the creator himself to enter his work would differ from a universally recognized number assigned by an independent authority (say, ISRC, ISBN for recordings and books respectively). Those skilled in the art of algorithmic information theory (AIT) can recognize that it is now possible to describe optimized use of binary data for content and functionality. The differences between objects must relate to decisions made by the user of the data, introducing subjective or cognitive decisions to the design of the contemplated invention as described above. To the extent that objects can have an optimized data size when compared with other objects for any given set of objects, the algorithms for data reduction would have predetermined flexibility directly related to computational efficiency and the set of objects to be monitored. The flexibility in having transparent determination of unique signal abstracts, as opposed to independent third party assignment, is likely to increase confidence in the monitoring effort by the owners of the original signals themselves. The prior art allows for no such transparency to the copyright creators.

Sample Embodiment 2

Another embodiment of the invention relates to visual images, which of course, involve at least two dimensions.

Similar to the goals of a psychoacoustic model, a psychovisual model attempts to represent a visual image with less data, and yet preserve those perceptual qualities that permit a human to recognize the original visual image. Using the very same techniques described above in connection with an audio signal, signal monitoring of visual images may be implemented.

One such application for monitoring and analyzing visual images involves a desire to find works of other artists that relate to a particular theme. For example, finding paintings of sunsets or sunrises. A traditional approach might involve a textual search involving a database wherein the works of other artists have been described in writing. The present invention, however, involves the scanning of an image involving a sun, compressing the data to its essential characteristics (i.e., those perceptual characteristics related to the sun) and then finding matches in a database of other visual images (stored as compressed or even uncompressed data). By studying the work of other artists using such techniques, a novice, for example, could learn much by comparing the presentations of a common theme by different artists.

Another useful application involving this type of monitoring and analyzing is the identification of photographs of potential suspects whose identity matches the sketch of a police artist.

Note that combinations of the monitoring techniques discussed above can be used for audio-visual monitoring, such as video-transmission by a television station or cable station.

The techniques would have to compensate, for example, for a cable station that is broadcasting a audio channel unaccompanied by video.

Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The specification and examples should be considered exemplary only with the true scope and spirit of the invention indicated by the following claims. As will be easily understood by those of ordinary skill in the art, variations and modifications of each of the disclosed embodiments can be easily made within the scope of this invention as defined by the following claims.

The invention claimed is:

1. A method for monitoring and analyzing at least one signal comprising:

creating, using at least one processor of an electronic system, a reference signal abstract of a reference signal; wherein said reference signal abstract is a data reduced version of said reference signal that is a self-similar representation of said reference signal;

receiving, in said electronic system, at least one query signal to be analyzed;

creating, using said at least one processor of said electronic system, a query signal abstract of said at least one query signal, wherein said query signal abstract is a data reduced version of said query signal that is a self-similar representation of said query signal;

comparing, in said electronic system, said query signal abstract with said reference signal abstract thereby determining whether said query signal abstract matches said reference signal abstract.

2. The method of claim **1** wherein said at least one processor comprises a first processor used for creating said reference signal abstract and a second processor used for creating said query signal abstract.

3. The method of claim **1** wherein said creating said query signal abstract comprises said electronic system using at least one of a hash and a digital signature.

4. The method of claim **1** further comprising:

creating, using at least one processor of a electronic system, a second reference signal abstract of a second reference signal; wherein said second reference signal abstract is a data reduced version of said second reference signal that is a self-similar representation of said second reference signal;

comparing, in said electronic system, said query signal abstract with said second reference signal abstract, thereby determining whether said query signal abstract matches said second reference signal abstract.

5. The method of claim **4**, further comprising changing selected criteria for generating said reference signal abstract from said reference signal.

6. The method of claim **4**, wherein said changing is in response to said electronic system determining that a query signal abstract matches one of said reference signal abstract and said second reference signal abstract.

7. The method of claim **1** wherein said creating, using said at least one processor of said electronic system, said reference signal abstract, comprises applying at least one spectral transform to said reference signal.

8. The method of claim **1** wherein said creating, using said at least one processor of said electronic system, said reference signal abstract, comprises analyzing characteristics of each signal in a group of audibly/perceptibly similar signals.

9. The method of claim **8**, wherein said group of audibly/perceptibly similar signals are versions of a particular song sung by different artists.

10. The method of claim **8** wherein said reference signal abstract comprises at least some common characteristics of said group.

11. The method of claim **8** wherein said reference signal abstract comprises only at least some characteristics of said group that represent the null case.

12. The method of claim **1** wherein said reference signal is a digital signal representing at least one of an audio signal, a still image, and a video image.

13. The method of claim **1** wherein said reference signal is a digital signal representing an audio signal.

14. The method of claim **1** wherein said reference signal is a digital signal representing a video signal.

15. The method of claim **1** wherein said electronic system is a computerized system.

16. The method of claim **1** further comprising said electronic system counting a number of times a query signal abstract is determined to match said reference signal abstract.

17. The method of claim **16** further comprising said electronic system counting a number of times a query signal abstract that originated from a particular source is determined to match said reference signal abstract.

18. The method of claim **16** wherein said particular source is one of radio broadcast station and an Internet site.

19. The method of claim **1** wherein said creating, using said at least one processor of said electronic system, said reference signal abstract, comprises massive compression of said reference signal.

20. The method of claim **1** wherein said creating, using said at least one processor of said electronic system, said reference signal abstract, comprises compression of said reference signal by a factor of at least ten thousand.

21. The method of claim **1** wherein said creating, using said at least one processor of said electronic system, said reference signal abstract, comprises determining bits having values deemed imperceptible to human senses.

22. The method of claim **1**, wherein said creating, using said at least one processor of said electronic system, said reference signal abstract, comprises lossy compression.

23. The method of claim **1**, wherein said creating, using said at least one processor of said electronic system, said query signal abstract, comprises lossy compression.

24. The method of claim **8**, wherein said group of audibly/perceptibly similar signals are versions of a particular signal.

25. An electronic system for monitoring and analyzing at least one signal comprising:

at least one processor;

a receiver configured to receive at least one query signal to be analyzed;

wherein said system is configured to use said at least one processor to create a reference signal abstract of a reference signal; wherein said reference signal abstract is a data reduced version of said reference signal that is a self-similar representation of said reference signal;

wherein said system is configured to use said at least one processor to create a query signal abstract of said at least one query signal, wherein said query signal abstract is a data reduced version of said query signal that is a self-similar representation of said query signal;

wherein said system is programmed to use said at least one processor to electronically compare said query signal abstract with said reference signal abstract, thereby determining whether said query signal abstract matches said reference signal abstract.

26. The system of claim **25** wherein said system is configured to apply at least one spectral transform to said reference signal when creating said reference signal abstract.

27. The system of claim **25** wherein said system is configured to massively compress said reference signal when creating said reference signal abstract.

28. The system of claim **25** wherein said system is configured to use said least one processor and perform lossy compression when creating said reference signal abstract.

29. The system of claim **25** wherein said system is configured to analyze characteristics of each signal in a group of audibly/perceptibly similar signals when creating said reference signal abstract.

30. The system of claim **29**, wherein said group of audibly/perceptibly similar signals are versions of a particular signal.

31. The method of claim **8** wherein said analyzing comprises performing on said reference signal at least one of linear predictive coding; z-transform analysis; root mean square analysis; and signal to peak determination.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,712,728 B2
APPLICATION NO. : 13/802384
DATED : April 29, 2014
INVENTOR(S) : Moskowitz et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Column 15 lines 53-56 Delete:

"6. The method of claim 4, wherein said changing is in response to said electronic system determining that a query signal abstract matches one of said reference signal abstract and said second reference signal abstract."

And insert:

-- 6. The method of claim 5, wherein said changing is in response to said electronic system determining that a query signal abstract matches one of said reference signal abstract and said second reference signal abstract. --

Signed and Sealed this
Seventh Day of October, 2014

Michelle K. Lee

Michelle K. Lee
Deputy Director of the United States Patent and Trademark Office

CERTIFICATE OF FILING AND SERVICE

I hereby certify that on this 6th day of January, 2016, I caused this Brief of Appellant to be filed electronically with the Clerk of the Court using the CM/ECF System, which will send notice of such filing to the following registered CM/ECF users:

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Upon acceptance by the Clerk of the Court of the electronically filed document, the required number of copies of the Brief of Appellant will be hand filed at the Office of the Clerk, United States Court of Appeals for the Federal Circuit in accordance with the Federal Circuit Rules.

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CERTIFICATE OF COMPLIANCE

1. This brief complies with the type-volume limitation of Fed. R. App. P. 28.1(e)(2) or 32(a)(7)(B) because:

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Dated: January 6, 2016

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